THE
ELECTRICAL REVIEW.

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COMBINED TENDERS.

ONE of the most prominent traits in our national character, which manifests itself in so many different and often unexpected directions, is the tendency to run in a groove. While it must be admitted that in some respects, such as, for example, political stability, this tendency has great advantages, it is equally true that in other cases, and especially in commerce and industry, its operation is frequently attended with most harmful results. We need not dwell on the old-fashioned methods and machines still in vogue in many of our workshops, the extraordinary infatuation of the British manufacturer for the two-pole type of dynamo, the delay in the adoption of electric light and motive power, the obstacles cast in the way of electric traction and of the large power schemes now afoot; our present purpose is to draw attention to a grievance, sorely felt by engine and dynamo builders, which appears to be almost wholly due to the influence of habit.

In the earlier days of electric lighting and direct coupling, when a 100-KW. set was a large unit, it was customary for the engine and dynamo to be mounted on a common bedplate and sold together. To avoid the multiplication of drawings and patterns a dynamo builder would adopt a certain type of engine, and as far as possible adhere to that type. From this practice, no doubt, was derived the custom of combining the specifications for the engine and dynamo in one, more especially as the whole installation was often placed in the hands of a single firm of electrical engineers. So far as self-contained coupled sets of small size—say, up to 100 KW.—are concerned, there is still no great objection to this custom.

When, however, one has to deal with large machines, such as are now being installed on all sides—thanks to the extremely rapid, though long-delayed, development of electrical undertakings—the case is entirely altered. Manufacturers have found it necessary to specialise more and more, and even when the contract for a complete undertaking of electric lighting or traction is given to a single firm, portions of it are invariably sublet, as no one firm can specialise in *everything!* Moreover, the engine and dynamo can no longer be built upon a single bedplate; they are, in fact, two absolutely distinct and independent units, made in different workshops, erected by different staffs, having nothing whatever in common save the shaft—sometimes not even that!

Now, this being the case, why, in the name of common sense, should the two things be specified and tendered for as though they were but one? Why should a man, who has a dynamo to sell, be compelled to buy and sell an engine also? Or why should an engine builder, who wishes to supply his engine direct to the buyer, be obliged to deal in dynamos in addition?

It may be said that it is an advantage to place the whole of the responsibility for the carrying out of the work upon

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the shoulders of a single firm; and no doubt there is some foundation for this view, especially on the part of the consulting engineer, whose duties are undoubtedly lightened thereby. Further, while it is an easy matter to conduct efficiency tests of the complete set on the simple basis of E.H.P. per I.H.P., which may be specified when both engine and dynamo are guaranteed by the one contractor, it is a very different matter to separately determine the respective efficiencies of the two machines. These considerations, however, are merely matters of convenience to the consultant, and do not affect the cost to the buyer or the quality of the plant.

On the other hand, there are several grave objections to the practice. In the first place, it is unjust to compel a contractor, willy-nilly, to assume responsibility for apparatus over the manufacture of which he has no direct control. Again, the inconvenience caused, not only to the successful tenderer, but to the whole body of competitors for the contract, is altogether out of comparison with the slight gain on the part of the consulting engineer. There are now, we are glad to say, at least a dozen well-known British engine builders of established reputation whose eyes have at last been opened to the importance of the huge electrical undertakings now in progress, and who are both capable and willing to furnish engines equal in size, efficiency and workmanship to those of any foreign maker; there are as many dynamo manufacturers ready to supply the generators. Let us suppose that, say, eight of each trade are in competition for a certain installation, where a single tender is asked for, to include both engine and dynamo. Each of the engine makers must obtain tenders from, say, half-a-dozen dynamo makers, and *vice versâ*; moreover, each of the 16 competitors will, in all probability, utilise these quotations in his tender to the purchaser, in the form of alternative tenders, according to the type of machine coupled to his own. Thus, in the case suggested, which is by no means exaggerated, no less than 96 tenders pass to and fro between the competitors, and almost as many alternative tenders confront the consulting engineer! As everyone of these tenders must be carefully considered, the task of judging them is sufficiently arduous—especially when, as in a recent instance, as many as six tenders lie within £500 of one another in a £30,000 contract, while the enormous amount of labour entailed on the part of the contractor is appalling to contemplate. Now, if two specifications were issued for the engine and dynamo (which involves practically nothing more than cutting the combined specification in halves), there would be *no* cross tenders, and only 16 tenders would be submitted to the engineer, of which two would be selected. What a difference!

But let us examine the matter a little more closely. What is the effect of the system on the price of the complete set? In the ordinary way a dynamo maker who buys an engine, adds, say, 5 per cent. to the cost of the engine before including it in his tender; an engine builder does the same, and as the engine is more expensive than the dynamo, there will clearly be a tendency for the engine maker's tender to be lower than that of the dynamo maker. Be this as it may, the purchaser, in any event, pays more for the set than he would have done were the tenders divided. Not only is the price higher, but it may conceivably be *much* higher; take the case where, for example, A wants to introduce his dynamos, and B wants to get a footing with his engines. Both makers, tendering separately, will quote their lowest prices—lower than they would name were they, by a combined specification, obliged to send out their quotations broadcast in advance to half a dozen manufacturers—and the engineer will be enabled to select these two, at a saving of perhaps 10 or 15 per cent. on the total price. Even should A and B by chance quote together on a joint specification, their price, as already pointed out, could never be so low as when they quote separately.

An honourable tenderer will not quote a lower price to, say, a Town Council than to a fellow-manufacturer for the same machine; his hands are bound. On separate specifications he can quote whatever he pleases, without scruples of conscience or fear of business complications—and the purchaser reaps the advantage.

We may remind our readers that the specifications for the Cardiff steam dynamos, drawn up by Mr. Ellis, which we dealt with in our last issue, were issued in separate form, leaving contractors perfect freedom. This is undoubtedly the proper course to pursue. Both engine and dynamo-builders stand to profit very considerably by the change, while the customer is even more the gainer. Nevertheless, this is the only instance, out of eight important contracts given out during the present year, in which the specifications were divided.

Surely it is time to get out of this well worn groove and to work according to the dictates of common sense.

American Wiring Practice.

The *American Electrician* for October contains a description of the wiring of an office building, which is interesting as an example of American wiring practice. The building, which consists of 13 floors, was wired while it was being built, and the wires were run throughout in iron tube lined with paper. The supply is obtained from a private plant installed in the cellar, consisting of two 25-KW. dynamos direct-driven by two high-speed steam engines. Mains running from this point feed a distributing fuseboard on each floor; these fuseboards have slate bases, and are enclosed in cabinets lined with slate; they are on the "spring-clip" principle. The main cables were each run in a separate tube, but the branch circuits were all run with both wires in the same tube. For the branch circuits running from the fuseboards, No. 14 B. & S. gauge wire was used throughout; each circuit carries from four to nine lights, the average number being six. The wire is insulated with vulcanised rubber, and covered with two braidings. Excepting in the cellar, where they are on the surface, all the branch circuits were run under the floors, the fittings being all of them flexible pendants (chiefly three-light fittings), and wall plugs for desk lights in the offices. The lights in the corridors are controlled by "push-button" switches fixed just above the fuseboards; none of the pendants or wall plugs in the offices have any wall switches, key-holders being used throughout. In this particular building, none of the partitions between the rooms were fixed until after the floors and ceilings were finished, so that it was impossible to run any of the wiring on these partitions, or to use any wall switches or brackets, and all the wall plugs were fixed on the skirting boards of the outer walls, near the windows. Cast-iron outlet boxes, porcelain-enamelled inside, have been used for all the pendants and wall plugs. Each box was designed and cast with the proper number and arrangement of openings for the particular place where it was used. Internally insulated tubes are much more generally used in America than they are here, especially for wiring new buildings. It is also the practice in America to use proper metal outlet-boxes with such tubes, and not to end them up in wood blocks, as is so often done here. It is interesting to note that solid wire so large as No. 14 is used for drawing into tubes; it is also notable that the wires are specially protected against abrasion by doubly braiding them.

THE POLLAK-VIRÁG TELEGRAPH.

Further Developments.

By CHAS. H. GARLAND.

(*Concluded from page* 633.)

It is unfortunate that the block representing the slip (fig. 9) in our last article should have been so indistinct as to give an erroneous impression of the clearness of the writing. We

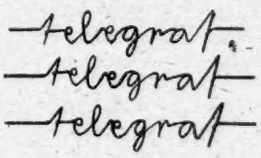
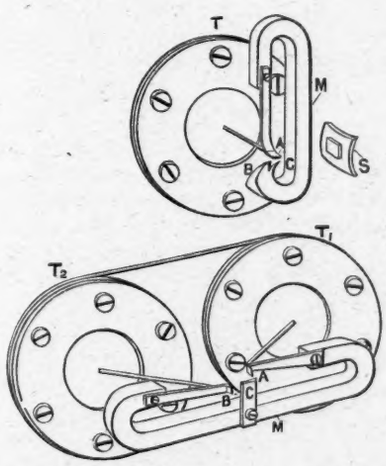


Fig. 9.

replace it by a better block in this issue. The writing on the receiving slip is very clear and distinct.

Having now obtained a view of the whole of the apparatus, it will be of advantage to look more minutely into the improved receiving apparatus and to give some details of the experiments in actual working of the new system.

First comes the altered arrangement of the telephone, the single telephone of the Morse-writer being replaced by a double telephone. Fig. 10 shows the way in which the



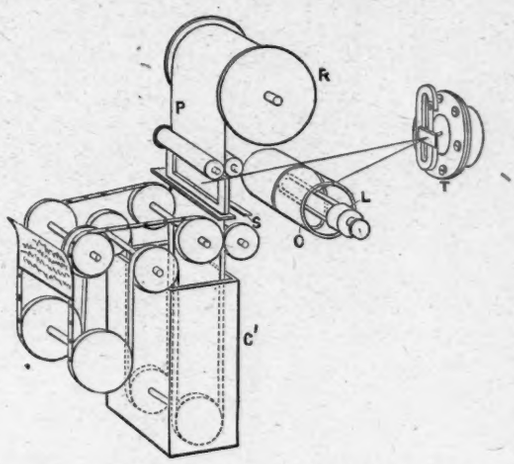
T, Telephone; M, Magnet; A, B, C, Magnetic points; S, Mirror.

Figs. 10 and 11.—Showing arrangement of telephones and magnetic points (fig. 10) in the Morse-writing apparatus, and (fig. 11) in the Latin-writing apparatus.

magnetic points, A, B, C, are arranged and connected with the diaphragm. A C-shaped magnet, M, is attached to the face of the telephone. One pole of this magnet terminates in the two points, B, C. The concave mirror, S, has on its posterior surface a soft iron plate. This plate attaches the mirror to the points, B, C, which thus form a horizontal axis of movement. The other pole of the magnet terminates in the spring-point, A, and this in turn forms a third connection with the soft iron plate of the mirror. By means of a tiny rod the diaphragm of the telephone, T, is attached to the point, A, and any movement of the diaphragm is communicated to it. The point A communicates the movements to the mirror and thus to the reflected light-ray, which produces a zigzag line on the sensitised paper.

In the new apparatus (fig. 11) two telephones are used. The magnet, although larger, is still C-shaped, but both poles terminate in a pointed spring. Point C is fixed; point A responds to the movements of T_1, and point B to the movements of T_2. The mirror is in construction the same, but now possesses two axes of movement in place of one.

In the earlier apparatus, as shown in the photograph accompanying our last article, the sensitised paper was stretched on a drum, which was displaced in a helicoidal manner, the writing being in helicoidal lines. It was necessary then to remove the paper and develop it in a dark room, which, however quickly done, necessitated some delay. The new apparatus (fig. 12) is much more practical, and can be adapted to either the Morse or Latin-writing apparatus. In the drawing the Morse-writing telephone is shown. This can, however, be replaced by the double telephone (fig. 11). A band of sensitised paper (P, fig. 12) is wound on the drum



R, Drum; P, Sensitised paper; L, Lamp; C, Cylindrical lamp cover; T, Telephone; C^1, Fixing bath; S, Scissors.

Fig. 12.—Showing arrangement of sensitised paper and automatic fixing apparatus. The Morse-writing telephone only is shown here, but it can be replaced by the double telephone.

R, and enclosed in a box. This paper is 7 cm. in width. It is unwound in a downward direction, and, passing between the two rollers shown, comes into the path of the reflected light-ray. The light-ray is moved from left to right independently of the oscillations of the telephone membrane. To secure this movement an oblong incandescent lamp, L, is employed. This lamp is covered by a cylinder, C, which is capable of turning on its axis, and has a narrow slit cut in it in the form of a single turn of a screw. Through this slit a luminous image of a small part of the luminous filament is thrown, and falls upon the concave mirror. This is reflected as a single point of light on to the sensitised paper. The helicoidal slit, in consequence of the turning of the cylinder, exposes a continually changing portion of the filament, and as a further consequence, the angle of reflection is continually changing in such a manner as to cause the reflected luminous point to pass from left to right on the sensitised paper. The working of the paper is so adjusted that each complete turn of the lamp cylinder which carries the ray from left to right also carries the paper downwards a sufficient space to allow a further line being written.

After being thus exposed to the action of the light, the paper passes down into the automatic developing apparatus. In this there are two bands, furnished with small catches and guided by a series of rollers which traverse the developing and fixing baths, C, in the necessary order. The sensitised paper is attached to the catches of the bands, and is thus carried through the photographic baths. After passing through the baths the developed paper slip is taken from the bands, and leaves the apparatus ready for use. A pair of scissors, S, are attached beneath the writing space and allow of cutting the band at a single stroke, and at the same time stopping the unexposed portion of the sensitised paper ribbon by means of an attached clamp. The detached portion, however, continues its passage through the baths. In this manner it is possible to start the receiver at the same time as the message commences. The stoppage is performed by an employé at the receiving station, who watches the writing through a ruby glass window.

The support given to the inventors by the Minister of Commerce of Hungary has enabled them to make experi-

ments with the latest form of their apparatus on a working line. The Hungarian Postal and Telegraph Department lent for the purpose four telephone lines running from Buda-Pesth to Poszony. These four lines were connected with the laboratory of the United Electrical Company, of Buda-Pesth, and looped at Poszony, so as to form a circuit of 400 kilometres in length. The resistance of the line was 2,000 ohms. The messages sent were written in a perfectly legible and accurate manner, and the speed attained was 60,000 words per hour, or 1,000 words per minute. The French Government have asked that experiments should be conducted on the lines between Paris and Lyons, and arrangements are now being carried out for this purpose. The inventors are confident of continued success.

Speaking at the Congress of Electricians at Paris on this subject, Herr Pinter, the director of the United Electrical Company, of Buda-Pesth, said :—"There is no doubt that with this invention we have made a new and important step forward in the History of the Development of Telegraphy, and that the Pollak-Virág system constitutes one of the most interesting successes obtained during late years in the application of weak currents."

WHY ELECTRIC CAR WHEELS SLIP.*

By EUGENE C. PARHAM.

Under certain conditions one pair of wheels on a car will persist in slipping to such an extent that the car cannot be made to start at all. It is a fact noticed perhaps only by those who are interested in the running of the car, that such slipping generally takes place in curves or on grades and in its worst form on combinations of the two. It may seem peculiar that on grades the front pair of wheels, as a rule, do the slipping, while in curves it is generally the back pair. It is also a well-known fact among railway men that the wheels of double-track cars having four axles, but only two driving axles, slip worse than those of single-track cars having but two axles, both of which are drivers. In order to finally state the case and its causes clearly, it must be stated that the motors used in street car work are series-wound motors, and at starting they are, as a rule, connected in series. The same current, of course, passed through both, and the line voltage divides between them when the two motors are running along under normal conditions, as indicated in fig. 1.

After the car is started and running along with all of the resistance coils cut out and the motors in series, the resistance of the two motors is so low, compared to their counter E.M.Fs., that it can be neglected. We will assume, then, that the internal ohmic resistance is zero, and that the two counter E.M.Fs. in series alone limit the value of the current that the car takes. It is, of course, well known that the line voltage applied to any circuit distributes itself according to the resistance or opposition it meets; wherever the opposition or resistance is greater the drop is greatest. Referring to fig. 1, if the two motors are electrically balanced; if they

Fig. 1.

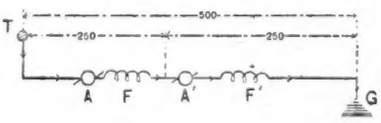
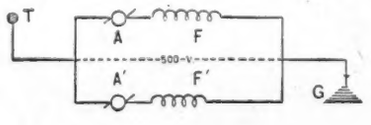


Fig. 2.



are geared so that one armature does not turn any faster than the other; if all of the car wheels are of the same size, and if the brush-holders are set right, the counter E.M.Fs. of the two motors will be equal. We will assume for the present that they are, and, consequently, that the drop across each of the motors is the same.

The speed at which a motor will try to run depends upon the voltage applied to its terminals. If this voltage is varied the speed will vary. This fact makes the behaviour of two motors running in series very peculiar under certain conditions. As a matter of fact, unless the two motors are either very small or are rigidly connected to the same mechanism or to each other, they cannot be run in series at all. This is true not only of series motors, but of shunt motors too. The two motors of a street car work together, simply because the wheels attached to both motors rest on the rails, and there is a certain amount of friction between the wheels and rails, so that the motors are, in a sense, geared together. The more weight there is placed on both motors, and the drier the rails, the less apt is either motor to slip, because there is more friction between the wheels and the rail, so the wheels do not slip so easily.

Now, if we grease the rail well under one pair of wheels, it will be found next to impossible to start the truck, especially if it is on a slight up-grade. As soon as the line voltage is applied, the pair of wheels on the greased part of the rail start to spin, and if the voltage is kept on, they spin faster and faster. To the ordinary observer it seems strange that the motor geared to the pair of wheels that do not slip does not get to work and run the truck over the bad spot. There is a very good reason why it does not, and this reason will be more readily grasped later. Now jack the truck up so that both pairs of wheels are lifted entirely off the rail (when this is done the motors must be jacked up too, to take the weight off the axles, otherwise the journals will run on the bottom of the boxes where there is no journal brass), and again apply the voltage. Both motors will start up in good shape, because the first rush of current is enough to start either of them, however badly it might be stuck.

After the motors start up, the interesting part of the experiment ought to come; if one motor runs easier than the other—that is, has less friction in its moving parts, or if the motors are electrically or magnetically unbalanced, so that the counter E.M.F. of one is lighter than that of the other, one motor will be observed to gradually gain in speed and the other to lose correspondingly. The motor losing speed may stop altogether, and it may not; whether it does or not depends upon a condition to be considered later. If it does stop it will not start again unless the current is cut off and the other motor is allowed to come to rest before the current is applied again. If it does not stop it will at least run much slower than its mate does. An example of this kind of running is often seen in hotels, where ceiling fan motors are used to cool the dining room. Two motors are often connected in series, and one can be seen to drive the fan blades a good deal slower than some of the others do. The slow motor does not stop because even the small current that its mate takes while running at high speed is sufficient to start it if it is very easy starting.

In the case of the two street car motors jacked up with the truck and running free, the speed of either motor can be increased by simply pressing a bar against the wheels of the other motor, giving it more of a load. If one end only of the truck is raised off the rail, the other end being left down, the action is about the same, when the voltage is applied, as in the case of the greased rail. The whole truck may give a little jump, due to the first rush of current, but it will not start.

All of these peculiar actions are due to change in the distribution of the line voltage. The line voltage drop across the motor depends upon its counter E.M.F., and this in turn upon its speed. If for any reason the speed of one motor drops a little its counter E.M.F. drops too. This allows the voltage at the terminals of the other motor to increase the total voltage remaining constant. Hence the other motor speeds up so as to raise its counter E.M.F. to meet the increased voltage. Each little addition of voltage that the faster motor gets across its terminals causes its speed to go up a little and with it up goes the counter E.M.F. This further increases the effective resistance of that part of the circuit and robs the slower motor of more voltage, causing it to slow down still more. Of course these interactions can take place only when the motors are in series, in which condition any variation in the speed of one motor will result in a

* *American Electrician.*

contrary change in the speed of the other one. As soon as the motors are thrown in multiple, as in fig. 2, each motor has an independent circuit of its own and each gets the whole line voltage across its terminals. If this line voltage is kept the same, ordinary variations in one motor circuit will not affect the other.

Now, in the case of a car climbing a steep grade, the car is in an inclined position, and most of its weight is thrown on the rear wheels, so that they have good traction—even better than they have when the car is on a level. On the other hand, the front wheels have not their share of the weight, so that their grip on the rail is less than it is when the car is on a level. The result is that the resistance to the rotation of the front axle is so low that it is an easy matter to send through the two motors current enough to turn the front axle independent of the rail. As soon as the front axle begins to turn, the counter E.M.F. of its armature runs up and monopolises most of the line voltages; this causes a further increase in the armature speed, with the result that the wheels get to spinning, and then there is no hope of moving the car, because the counter E.M.F. of the spinning armature cuts the value of the current down so that the rear motor, which has good traction, has no power to move the car.

The only thing to do in such a case is to throw the power off, give the rail sand, and throw the power on again, more gradually. It sometimes helps matters a little to take up the brakes about a half a turn; this keeps the wheels from spinning so readily. As a final resource it may be necessary to throw the motors over to multiple; in such a case the controller should never be carried further than the first multiple notch until the car has fairly started.

If a man does not know how to take a car around a curve, or if he allows his car to stop in a curve, there is more wheel slipping; but, as above stated, it is the rear wheels that slip, as a rule, because the forward ones are further around the curve and are more tightly bound. After one pair of wheels begins to slip the car loses its traction for the same reason that it did in the previous case. In the case of the curve, it is a waste of power and wheel treads to keep the current on steadily and try to have the car grind itself out of the curve. The first thing to do is to set the brake up a little, give the rail sand and throw the power on and off. If this does no good, give the controller one reverse notch and as soon afterward as possible a notch ahead, and at the same time have as many passengers as possible jump up and down on one of the platforms. This will generally get the car out. If it does not, the only thing to do is to throw the motors over to the first notch in multiple. The best way to avoid all curve troubles is never to allow the car to stop in the curve, even if it does shake up the passengers a little.

NOTES ON THE TESTING OF MODERN DIELECTRICS AT HIGH VOLTAGES.

By J. WRIGHT.

In these days of electric light and power distribution at increasing voltages, the erstwhile familiar phrase of "— megohms per mile," as specifying the quality of the insulating medium or dielectric surrounding a wire or cable, is being rapidly superseded amongst manufacturers, consulting engineers, and others more or less directly concerned in these matters, by the resistance of that dielectric to disruptive discharge, in terms of the number of volts of E.M.F. to which the cable or wire is subjected before being brought into commercial use.

It is obvious, if we regard this matter in a practical light, that the change is materially for the better, and will benefit both manufacturer and customer, in that it denotes the true value of the dielectric as an insulating medium; a rubber-insulated wire, yielding an insulation resistance of some hundreds of megohms per mile under a testing E.M.F. of 600 volts continuous, may break down immediately under the application of 600 volts alternating, whereas a fibre or oil-insulated main, take, for instance, the Brooks semi-solid system of insulation, though yielding under test only a fraction of a megohm per mile, will withstand a pressure of as much as 20,000 volts alternating without perceptible change. Taking these facts into consideration, it is obviously impossible to compare the merits of various dielectrics, or even various qualities of the same dielectric, in terms of megohms per mile, while, on the other hand, by subjecting two entirely different samples of insulating material to a high voltage stressing, or, as it is technically known, "straining," test simultaneously, at regular intervals of their respective "lives," it is possible to judge, with some degree of accuracy, their respective merits.

So important has this matter become, that in many cases specifications for cable contracts lay particular stress upon the resistance of the dielectric to disruptive discharge, the general rule being that it shall be subjected to a testing pressure or voltage at least double that at which it is ultimately intended to work for a certain predetermined period, and (here we have an important point) that the megohmic result obtained after this stressing or straining test shall evidence no perceptible deterioration in the insulating qualities of the dielectric.

To meet the increasing popularity of this form of test, all the leading cable manufacturers have for some considerable time now provided the requisite plant for the purpose, such plant usually taking the form of an alternator yielding various low voltages over a convenient range, up to, say, 250 volts, which are then transformed by a suitable transformer, or bank of transformers, up to the required voltage, which may be anything from 1 to 20,000 volts alternating.

In order to undergo the test, the cable, if it be a simple rubber-covered core for example, is immersed in a tank of water with its extremities free, for a certain predetermined period, usually some 24 hours. A careful insulation test is taken on it in the usual manner by the direct deflection method, and the secondary (high tension) winding of the transformer is then connected to one extremity of the cable or core, and to the tank, respectively, the latter connection being usually made by means of an earth plate immersed in the water; the remaining end of the cable being left free. The alternator is then gradually speeded up until the voltmeter indicates the required voltage, which is maintained for the requisite period, after which the machine is *gradually slowed down*. It is better for all purposes to place two voltmeters in circuit, one across the terminals of the alternator, and the other (usually electrostatic), between the extremity of the core under test, and earth, in order to indicate the exact voltage to which the cable is being subjected. If the multiplying power of the transformer be known, the one instrument then serves as a check upon the other.

It will be noted a few lines above, that special stress is laid upon the gradual slowing up of the alternator after the completion of the test; careful attention to this detail admits of an ordinary insulation test being made shortly after the stressing test. If, on the other hand, the voltage be suddenly cut off, in either the primary or secondary branch, it leaves a static charge in the core, which, more especially in a cable of high inductive capacity, tends to interfere with the subsequent galvanometer test, and requires the core to be connected directly with earth for a period proportional to that during which the high voltage was maintained, in order to dissipate itself.

In the case of a lead-sheathed or armoured cable, the lead sheathing or other metallic covering, of course, takes the place of the water in the tank, thus rendering immersion unnecessary.

One point which has been noted in the stressing or straining of insulated core, especially where the voltage employed approaches that at which the limit of resistance to disruptive discharge is reached, is the apparent accumulation of potential at the points or extremities of the cable, which makes itself evident in the breaking down of the dielectric at the point where it enters or leaves the water, or, if dry, at the point where the lead or other sheathing ends. Various plans have been suggested from time to time to remedy this unfair distribution of potential, and to maintain it uniform at all points of the core. Probably the most likely one to have the desired effect is that of introducing a bank of lamps or other suitable high resistance between the free extremity of the core and earth, the number of lamps or other resistance

being proportional to the voltage under application at the time. There would then be a complete circuit for the high voltage, while, at the same time, provided the plant were sufficiently powerful to maintain the potential under these conditions, that difference of potential would still exist uniformly at all points between conductor and earth, and all tendency to accumulation at the extremities would be prevented by the high resistance path to earth. The only drawback to such a plan is the enormous increase of power required, especially in the case of high voltages. High-voltage testing under normal conditions, in the case of cables of average inductive capacity, such as quarter-mile lengths of the ordinary 19 or 37 strands, for instance, requires the initial expenditure of anything up to 10 H.P., and that on a blind or condenser circuit, whereas the adoption of a plan of connections such as the one mooted above would involve the doubling or even trebling of that output, and this in a factory turning out some hundreds of miles of various types of insulated core in a week, would be a material consideration tending to a general rise in the price of all cables and wires subjected to such tests—a condition of things to be, if possible, avoided.

Another difficulty in the way of successful high voltage testing is the efficient insulation of plant, and this more especially when dealing with voltages of 10,000 and upwards. There is no special design of transformer suited to the exigencies of cable testing, wherefore manufacturers in general have adopted one of the many well-known types of transformer on the market, and secured whatever extra insulation they could by insulating the case, oil-bath immersion, &c., all of which, though tending to the object in view, viz., the maintenance of a high potential, are highly unsatisfactory in that they are unreliable and open to breakdown at unexpected moments. Taking the question of oil-insulated transformers into consideration, it is obviously impossible to build an oil-immersed unit of any useful capacity for this type of work without proceeding to impracticable dimensions, whereas, with the ordinary air-insulated types, unless great care be taken in their construction and erection, constant trouble is experienced in their breaking down at various unexpected points.

What is really required is a highly insulated type of transformer having a capacity of from 20 to 30 H.P., capable of adjustment over a wide range of potential, either by subdivision or otherwise, which will enable voltages varying from 1 to 20,000 to be obtained at all times with perfect security from breakdown.

In the matter of actual testing there is no hard and fast rule as to the actual voltage to be applied to any particular class of cable or wire, the general rule being that quoted above, viz., at least twice the normal working voltage; but conditions, of course, vary. With dielectrics of an impregnated fibrous disposition, such as jute, paper, &c., the testing voltage may be in terms of the radial thickness of the insulating medium, always provided that the actual nature of that medium remains unchanged. With rubber-insulated core this rule does not apply, but depends to a large extent upon the quality of the rubber employed.

The old-time practice of "flashing" the live lead on to the end of the core was altogether an unfair and unsuitable test, in that it imposed enormous momentary potentials due to induction and kindred effects upon the core. The present system of steady application for periods varying from ten minutes to an hour, or even more, forms by far a more suitable method and amply guarantees the insulation of the core. To this end it is frequently specified that such tests shall be carried out like the ordinary galvanometer tests in the presence of the consulting engineer or his representative.

DANGEROUS ELECTRICAL PRESSURES.

An important investigation has recently been carried out by Prof. Weber, of Zurich Polytechnic, on the physiological effect of alternating electric currents such as are used with overhead trolley wires. The occasion of the experiments was a dispute between the firm of Messrs. Brown, Boveri and Co., Switzerland, and the authorities, with reference to the proper pressure for two electric railways to be worked by three-phase alternating current, the proposal being to work them at 750 volts. This pressure being considered dangerous by the authorities, the question was referred to Prof. Weber.

Prof. Weber's experiments* were made with reference to the special circumstances of the above railways, where the current was supposed to be supplied through two overhead leads, the rails being used as the third conductor of the three-phase system. The effect of the current was determined in two cases, namely, when a person seizes the two bare leads with both hands simultaneously, and when a person, standing on the railway or a car, touches one of the leads.

In the first case an experimental apparatus was used in which the pressure between two bare wires, grasped in the hands, could be increased by steps of 10 volts, the frequency of the current being 50 per second. Prof. Weber tried these experiments on himself, in the first place with the hands wet, and, in the second place, with the hands dry. When experimenting with wet hands, he found that 50 volts was the highest pressure he could endure. The effect produced with this pressure is described as "instantaneous paralysis of all the muscles of the fingers, hands, and arms; the wires could not be released; the state being endurable for 2 seconds at most, it was impossible to measure the current." With dry hands, he found that 90 volts was the highest limit of pressure that could be used; much the same unfavourable symptoms appearing as with wet hands at 50 volts.

From these experiments Prof. Weber concludes that:—"A simultaneous touching of both of the poles of an alternating current circuit is dangerous as soon as the pressure exceeds 100 volts; and since it is impossible to set oneself free, the case must be regarded as fatal whenever immediate help is not at hand."

Altogether different results were obtained when the professor stood on the ground and touched one of the leads with one hand. By using a series of 100-volt glow lamps, the pressure was gradually increased by steps of 100 volts. Standing on moist gravel, from which he was rather well insulated by means of his shoes, he was able to endure pressures up to 2,000 volts, this pressure, however, producing very disagreeable effects in the form of violent stinging of the skin, and intense trembling of the fingers. Standing on clay covered with coal dust, 1,300 volts was the utmost pressure that could be endured.

From this last series of experiments, it will be obvious that to touch one of the leads is not dangerous, as long as the pressure does not exceed 1,000 volts.

A contemporary endeavours to minimise the value of Prof. Weber's conclusions, by pointing out that millions of volts can, with impunity, be applied to the human body from a small Leyden jar. But this does not appear to have much to do with the case, since it is the cumulative effect of an alternating current continued for some time that produces the dangerous paralysis observed, and in every high tension electric supply we have the continuous condition which is absent in the Leyden jar. Another contemporary concludes that since all pressures between 100 volts and 1,000 volts are equally dangerous, there is no reason for not using the higher pressures between 500 and 1,000 volts, especially as they lead to greater economy in the working of the electric railway.

It is of little use to point out that some persons can bear with safety a much higher pressure than others, owing probably to their higher electrical resistance, since the man of high conductivity must also be protected. A lower frequency might also be safer, but 50 is not very high, and is pretty common in practice; the increase of safety obtained by changing the frequency is not likely to compensate for the technical disadvantages.

The outcome of this exceedingly valuable investigation appears to us to be that no pressure which would make economical working possible is safe, if a person grasps two opposite leads simultaneously with bare hands. It ought to be easy to make this impossible for passengers, by making the two leads sufficiently inaccessible, and workmen ought to be instructed to use the well-known and simple safeguards available to

* See *Nature*, August 23rd, 1900.

600 volts continuous, may break down immediately under the application of 600 volts alternating, whereas a fibre or oil-insulated main, take, for instance, the Brooks semi-solid

the desired effect is that of introducing a bank of lamps or other suitable high resistance between the free extremity of the core and earth, the number of lamps or other resistance

protect them. For the authorities to insist that the pressures in power transmission conductors should be reduced till it was safe for the lieges to handle them, would be like insisting that the speed of railway trains should be reduced till it was safe for the ordinary foot passenger to cross in front of them.

Prof. Weber's experiments are of the greatest importance, in showing that the live conductor is dangerous at much lower pressures than was formerly supposed, and that the live conductor, even of 500 volts, is not to be trifled with.

THE USAGE FACTOR OF PLANT.

It should ever be the object of engineers to ascertain whether they are securing from their plant as much duty as is being secured by others. Very much of the success of a business will depend upon a proper and economical factor of usage. This factor is but little understood, and it is applied to a very limited extent. The load factor of a lighting station is bad because the plant must be worked many hours at a very small duty, yet its capacity must be such as to enable it to furnish the maximum demand for a few minutes every day—nay, for perhaps a few minutes on one day in the course of several years. In this respect the electric light station does not possess the advantage of the gasworks. The load factor of a gasworks is good, because there is a provision for holding many million feet of gas, and the generating plant runs at mean load for long hours—in fact, continuously—whereas electricity is supplied in a hand-to-mouth fashion, and can only be stored in an inefficient manner. A grasp of the facts underlying the question of load factors is necessary to assist in all economic design, or to point the direction in which improvement is to be sought.

In designing plant it is necessary to know something about the limits and proportions of its several parts. It is impossible to obtain with small plants in electrical work other than poor load factors for the plant. There must be two boilers. The usage factor will be 50 per cent. and the load factor may be 100 per cent. for the boiler that is at work. The load factor of such a station would thus be 50 per cent. of its boiler power.

There would be two engines at least. The use factor would be 50 per cent., but the running engine would have a load factor of perhaps 20 per cent. The station load factor is thus only 10 per cent referred to the engines or to the generators. With larger undertakings the proportion of spare plant rapidly diminishes, while the load factor of the running plant will also increase. Power can thus be generated much more economically on a large scale than on a small scale. To carry the question further, let it be supposed that the power is to be employed on a tramway. Cars will be necessary for this purpose. Out of a total number of cars only a proportion can be usefully employed. The remainder will be more or less under repair. The ratio of employed to total cars is the use factor of the cars to some extent. But there is a use factor for the running cars. An inspection of the statistics of many tramways would reveal the fact that, according to the nature of the traffic, the facilities for repairs and other more or less determining factors, the number of cars on the line may be as low as one-third the total stock, while it may exceed two-thirds. This use factor is, of course, fixed by the traffic. If this is steady all day it will tend to raise the use factor. If there are slack periods, many cars will come out late and return early, and will reduce the factor.

But of the average cars out of the shed, as calculated from the total working hours of the cars and the hours run by the generating plant, it may be said each car should run its 80, 100, or 140 miles per day. If such a mileage is not secured, then the mileage factor per car is too low.

It will often be found that systems which have a poor use factor for their cars may possess a good mileage factor. The combination gives the net factor. It is convenient to assume that a car should run 100 miles per day. This simplifies the calculation of the use factor.

It is all a question of design of cars and provision of plant and men for repairs whether the average cars on a line shall or shall not bear a large ratio to the total rolling stock. With a simple system of interchangeable parts, a ready means of disconnecting leads and brake rods, the provision of car bodies need not be so liberal as the provision of trucks to carry them. It should be—in fact, it is—possible, to run cars into a shed, lift the bodies off the trucks by a rapid crane, run out the trucks and run other trucks in their place, lower the body, couple up connections and run the car on service again. For want of such provision, and because of the general use of the inefficient four-wheeled enlarged horse car, these things are not done. Engineers see the needs of the case plainly enough, and are capable of economising capital in this way. The facilities necessary to do it might be paid for out of the economy in car sheds that would be effected, for spare cars occupy more room than trucks, and with travellers' trucks can be stored closely—they do not require rails on which to stand in reserve. It is all a question of calculation, observation, and the provision of facilities, and it is certain that too little importance is placed on these subjects and too much on certain others. Thus, the earning of so many pence per car mile is considered important; it is less important than it appears. What is being earned per car by every car owned? How many car miles, moreover, are run over every mile of track? The use factor of a car depends to a quite considerable extent upon the line being double or single, or, if the latter, on the proper location of turnouts, for the mileage of every car is limited by the most unfavourably placed loop, and the provision of double track will not only enable a very material increase in the mileage per car, but will reduce the cost of wheel renewals and car repairs generally.

The whole question of use factors and load factors is one deserving of much greater attention than has hitherto been accorded it. The comparisons and figures may be carried into the further items of passengers in order to show the general traffic factors, and the same principles may be carried into all lines of engineering with advantage. Without such statistics focussed on a few salient points, correct conclusions are not easily to be drawn. The statistics enable results to be traced from causes in a manner not otherwise possible.

THE E.M.F. OF ALTERNATORS ON OPEN CIRCUIT.

By C. C. HAWKINS.

The E.M.F. which a given alternator will induce when running on open circuit is usually predetermined during its design from an equation based on the E.M.F. which would be obtained from a continuous-current dynamo, similarly wound and run in the same field system. Thus the effective E.M.F. generated per phase is expressed by the equation,

$$E = K \cdot 2 Z_a \times \frac{p N}{60} \times \text{no. of inductors in series in one phase} \times 10^{-8} \text{ volts},$$

where Z_a is the total number of C.G.S. lines entering into the armature from one pole and forming one magnetic field, and $\frac{p N}{60}$ is the frequency due to the p pairs of poles. The average E.M.F. of the analogous continuous-current dynamo has therefore to be multiplied by a certain coefficient K, which may itself be analysed as the product of two factors, k' and k''. The first of these is the "form factor" of the E.M.F. curve, or the ratio which the effective E.M.F. as given by the square root of the mean square, bears to the real average E.M.F. The second may be termed the "width coefficient," and is the ratio which the real average E.M.F. bears to the gross average E.M.F. when differential action is supposed to be absent, and all the lines are assumed to be usefully cut as in the continuous-current dynamo. Both factors are dependent in the first place on the ratio of the pole-width to the pitch; they are also equally dependent upon the ratio which the width of the winding bears to the pitch, or if the armature be slotted and one side of a drum

coil is distributed among more than one slot, upon the relative position of these slots. Both of these ratios affect not only the shape or form of the curve, but also the greater or less extent to which differential action is present.

In the calculation of the values of K, it is usually assumed that the flux from a pole is strictly confined to the width of the pole-face, and is uniform over its whole area, so that the half-wave of E.M.F. given by a single inductor or group of inductors in one slot would enclose with the abscissa axis a rectangle. It is, however, of interest to estimate in what way and to what extent this confessedly approximate assumption may lead us into error, and the endeavour of the present paper is to take into closer account the fringe of lines which must necessarily surround the actual pole-face, and which shades off from the normal induction under the pole to zero at the interpolar line of symmetry. For this purpose the curves of induction in the air-gap for various ratios of pole-width to pitch may be drawn after the method given in Mr. F. W. Carter's note "On the Air-gap and Interpolar Induction," communicated to the *Journal Institution Electrical Engineers*, Vol. xxix., p. 925, and in fig. 1 are given three such curves,

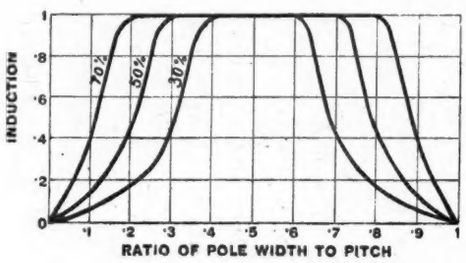


Fig. 1.—Flux-Distribution along Pitch-Line.

plotted from fig. 6 of Mr. Carter's paper. The assumption has been made that the length of the single air-gap is $\frac{1}{20}$th of the pitch, so that if the pole-width be 0·7, 0·5, or 0·3 of the pitch, the ratio of the half interpolar gap to the air-gap or $\frac{c}{l_g}$ is 3, 5, or 7, and similarly for other proportions of pole. Thus with a pitch of 10 inches, the length of the air-gap is assumed to be 0·5″, or with a pitch of 6 inches as in a small machine, to be 0·3″. But little error is introduced, if these proportions are only approximately true. In the following diagrams two sets of curves are drawn, those in dotted lines on the assumption that there is no fringe, and those in full lines after taking into account the fringes shown in fig. 1. If the average E.M.F. of a single inductor or group of inductors in one slot, passing under a pole of width equal to

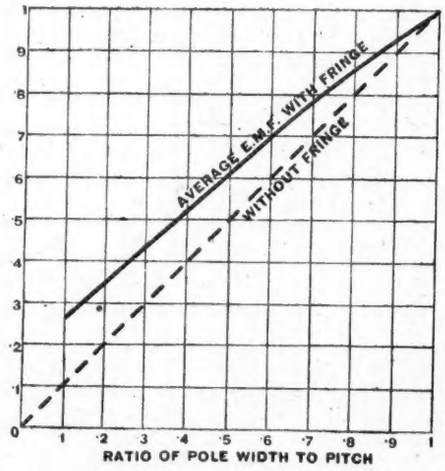


Fig. 2.—Average E.M.F.

the pitch, be represented by 1, the average E.M.F. for other ratios of pole-width without fringe will fall in the straight dotted line of fig. 2. The full-line curve of fig. 2 shows the average E.M.F. given by the integration of the areas of the curves of fig. 1, and upon this will be based our subsequent results. It will be seen to diverge more and more from the dotted line as the pole-width decreases.

I.—Slotted Armatures.

Taking first the case of an alternator with slotted armature, the side of each drum coil may be wound in one or more slots, and of recent years the tendency has been to adopt more than one slot per pole and phase. Such a division of the coil which may be called "grouped distribution," must lead to a reduction in the effective E.M.F. since the several groups which are in series are more or less out of phase with each other; yet it has the advantage that it decreases the inductance of the armature, and from the spreading of the winding a greater cooling surface is exposed, especially at the ends of the coils. If the curve of instantaneous E.M.F. for each group were sinusoidal, it would be easy to find the resultant E.M.F. of two or more groups which differ in phase by adding their several E.M.F's. vectorially. But since the instantaneous E.M.F's. are not sine curves, this method is out of the question, and with all except the simplest shapes, the compounding is best done graphically.

(To be continued.)

CORRESPONDENCE.

Re Record Joint Making.

In your issue of the 12th inst. you described a joint box for use on concentric cables. You also stated that the price of service boxes of the old pattern was between £2 and £3 each.

It might interest your readers to know that the service boxes in use on the Edinburgh mains at the present time cost about 15s. each, complete, and are made to take two services.

They can be easily put on in an hour, and can be also easily disconnected either way without stopping the supply, and can be used either as straight or T joints or four-way with the same fittings. Any handy man can fix them on, they are so simple.

The No. 1 box is 3½ inches deep, 7½ inches wide, and 8 inches long, made in four parts, and is capable of taking a 1 square inch or ·06 concentric main and two 7/14 or 7/16 services (concentric).

The No. 2 box is 4 inches deep, 9 inches wide, and 10 inches long, and is capable of taking any size of concentric cable up to ·1, and can be disconnected either way with safety when the current is on.

I may state the box and fittings are my own invention, and we have several hundreds in use on our high and low tension mains here, and have never had a single breakdown with one of them yet.

Ernest Francis Hammond,
Foreman, Mains Department, Edinburgh Corporation Electric Lighting.

Power from Blast Furnace Gas.

I have been greatly interested in the series of articles on the utilisation of blast furnace gas for power purposes. The series is not yet complete, and so I am, perhaps, a little premature in attempting a suggestion for the improvement of the system. The scarcity of coal, coupled with the much greater thermal efficiency of the gas engine over the steam engine, at once indicates the desirability of every possible improvement in the gas engine in order that our remaining coal supply may be turned into work in the most economical manner. The suggestion I have to offer may increase the combined efficiency of the furnace (as a producer) and the gas engine itself, since it gives the gas engine an opportunity it has longed for of utilising some of its waste heat. My figures are based upon those given in the Electrical Review.

Suppose the air blast *not* to be heated directly by a portion

of the gas evolved, but by passing the exhaust pipes of the engines through a firebrick chamber, constituting a heater for the air blast, somewhat after the principle of the ordinary feed-water heater of steam practice.

We may now consider the effect this system of heating the air will have upon the combined efficiency of the plant. It is not fair to attribute the increase to any virtue of the gas over the steam engine, but when a gas engine is worked by a blast furnace requiring its blast air heated, the advantage is obvious.

Total volume of gas evolved per hour ... = 455,260 cubic feet.
Unavoidable loss, say, 20 % (probably less) = 91,052 „

Volume available for power ... ... = 364,208 „

Taking the heat developed per cubic foot at 100 B.Th.U., the heat units contained in this quantity of gas ... ... = 36,420,800 B.Th.U.

One H.P.-hour, theoretically $= \frac{33{,}000 \times 60}{778} =$ 2,545 „

The equivalent theoretical H.P. $\therefore = \frac{36{,}420{,}800}{2{,}545} =$ 14,330 H.P.

The thermal efficiency of the gas engine = 28 per cent.
Therefore, actual power developed ... ... = 4,012 H.P.

The engine will dissipate the heat in the following proportions:—

Heat converted into work = 28 % ... ... = 10,197,824 B.Th.U.
Heat absorbed by jacket water = 40% ... = 14,568,320 „
Heat carried out with exhaust = 32 % ... = 11,654,656 „

Total heat accounted for ... ... = 36,420,800 „

Now the heat required to raise the air for blast through 1,000° F. is—

$$\cdot2374 \times 1{,}000 \times 26{,}813 = 6{,}365{,}406 \text{ B.Th.U.}$$

The amount of heat put into heater = 11,654,656 B.Th.U. Hence the efficiency of the heater need not exceed

$$\frac{6{,}365{,}406}{11{,}654{,}656} \times 100 = 54{\cdot}6 \text{ per cent.}$$

The percentage of heat put into the engine which is thus utilised for heating the air is

$$\cdot546 \times \cdot32 \times 100 = 17{\cdot}5 \text{ per cent.}$$

And the real loss by exhaust is, therefore, 32 % − 17·5 % = 14·5 %
Adding the jacket loss ... ... = 40 %

Total loss ... ... = 54·5 %

The useful efficiency of the engine thus becomes 45·5 per cent. as against 28 per cent. previously obtained by the stove-heating process.

The increase in the power obtained is therefore 4,012 − 2,130 = 1,882 H.P., or an increase of over 88·4 per cent., a result the commercial value of which requires no comment.

There should be no difficulty in constructing a heater on this principle having an efficiency of 54·6 per cent., and it would be an exceedingly cheap and simple affair.

As above stated, the suggestion may already have occurred to the writer of the article on blast-furnace gas. If so, may I apologise for taking up so much of your space?

On the other hand, if this idea is original and practicable, I trust it may be found of value in assisting the economical use of blast-furnace gas for power purposes.

Ivon M. de Havilland.

[Mr. Havilland's suggestion seems to us to be perfectly practicable, though at present, while abundance of gas is going to waste, economy is not so important as it will become in the future. We may remark, however, that the efficiency of the *engine* is not increased by the proposed arrangement, but that of the system as a whole. Moreover, even if the loss in the exhaust were really only 14·5 per cent., the efficiency of the engine would be $\frac{28}{14{\cdot}5 + 40 + 28} \times 100$, or 34 per cent., not 45·5 per cent. An unfortunate error occurred in our own figures, which will be corrected in the next article; the available power should be 2,880 H.P., not 2,130 H.P. as stated, so that Mr. Havilland's suggestion would lead to a gain of 1,132 H.P., or 40 per cent.—still, no small item.—Eds. Elec. Rev.]

The Largest Motor-Generator Plant.

Kindly allow us to draw your attention to an inaccuracy which has occurred in this week's issue of your publication in a notice with reference to the new plant which is being put down by the Metropolitan Electric Supply Company, Limited, of London.

It is stated therein that the motor-generator station will, with a total capacity of 3,250 KW., be the largest in the world. This statement is erroneous, inasmuch as the well-known Santa Radegonda motor-generator station, in Milan, to which power is transmitted from Paderno over a distance of over 20 miles at a tension of 15,000 volts, has a total capacity of 3,870 KW. Power is distributed both by overhead and underground lines.

Aktiengesellschaft, Brown, Boveri & Cie.
C. Brown, W. Baerloch.

Baden, *October 20th*, 1900.

Interior Wiring.

Mr. Fennell makes some very curious statements in his last letter. He says, "No one would dream of using batteries of large size for balancing." Yet batteries are actually used for balancing in most continuous-current three-wire stations, both large and small. Perhaps he means that no one would rely solely on a battery for balancing; this is possibly true, but it is quite another matter. If a good-sized battery were connected in parallel with the small balancer he refers to, it would be impossible for the voltage to rise to any serious extent on one side of the system, even if the other side were shorted. Even when the mains are not intermittently earthed, they get shorted now and then, and I repeat that in any properly-designed station it should be impossible for such shorts to cause the voltage to rise seriously. A station should never be solely dependent on a small balancer which may be thrown out by a fault on the mains; if there is no battery, some at least of the dynamos should be run two in series; this is done in several small modern stations, Rathmines, for instance.

Again, Mr. Fennell says that "he would like to hear of any large network in this or any other country where the middle wire is intentionally dead earthed." Well, Manchester, Liverpool, Brighton and Glasgow are the first examples that occur to me. At Glasgow, it is true, the middle wire is earthed through a resistance consisting of 12 100-c.p. lamps in parallel, but even this is a very different thing to the test lamp referred to by Mr. Fennell.

Yet again, Mr. Fennell says "there are few large stations where none of the mains have an elusive and undiscoverable earth." Surely this is a libel on our station engineers; perhaps Mr. Fennell is thinking of the fact that the total insulation resistance of large networks is low, sometimes only an ohm or two, but this leakage is distributed over the whole of the mains and consumers' wiring, and is not due to any one earth, and I cannot see that it affects the question of intermittent earthing. If there are any wandering earths about of the kind Mr. Fennell speaks of, I should say that the sooner they are burnt out the better.

Mr. Fennell seems to be under the impression that I have claimed to be the originator of the "earthing idea." How he got that impression I am sure I do not know, for, of course, I have made no such extraordinary claim. The principal object of my article was to point out that the combination of double wiring, enclosed throughout in earthed metal sheathing, with alternate earthing of the mains at regular intervals, gives all the advantages of concentric wiring with uninsulated return, without its disadvantages, and so far as I am aware, the suggestion is novel.

As to Mr. Fennell's claim for "credit," I will simply say that none of the suggestions made, or opinions expressed, in my article, were in any sense originated by Mr. Fennell.

G. C. Allingham.

Glasgow E. L. Works.—Amongst the gentlemen mentioned in connection with the Glasgow Corporation electric lighting undertaking, we, unfortunately, omitted to give the name of Mr. Alexander Adams, the assistant mains superintendent. This gentleman has been with the department almost since the commencement of the undertaking, and has given infinite assistance to Mr. Ward. The district superintendents of the mains department are Mr. Slaughter, Mr. Black, Mr. Smythe and Mr. Miller. They have also all put in good work.

E

ratios of pole-width without fringe will fall in the straight dotted line of fig. 2. The full-line curve of fig. 2 shows

REVIEW.

Suppose the air blast *not* to be heated directly by a portion

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING OCT. 24TH, 1899.		WEEK ENDING OCT. 23RD, 1900.	
Albany	Value £277	Alexandria	Value £41
Alexandria	15	Amsterdam	80
Amsterdam	110	Bombay	246
Boulogne	63	Buenos Ayres. Teleg. mat.	200
Brisbane. Teleg. mat.	200	Calcutta	683
Buenos Ayres	3,639	„ Teleg. wire	223
„ Teleg. mat.	100	Cape Town	25
Calcutta	553	Colombo	248
Cape Town	236	Copenhagen. Teleg. wire	136
Christchurch	75	Durban	802
Copenhagen. Teleg. cable	85	East London	60
Durban	241	Fremantle	214
„ Teleg. mat.	189	Gibraltar	84
Fremantle	52	Gothenburg	100
Gothenburg	12	„ Teleg. wire	396
Hamburg. Teleg. mat.	200	Hamburg	60
Hong Kong	714	„ Teleg. mat.	200
Kobe	856	Hiozo	48
Lyttleton	24	Hobart	210
Melbourne	41	Hong Kong	103
„ Teleg. mat.	1,032	Karachi	12
Montreal	77	Lyttelton	68
Nagasaki	13	Madras	108
Ostend	28	Malta	150
Otago	75	Melbourne	47
Perth	137	Monte Video	30
Port Elizabeth. Teleg. wire	317	Nagasaki. Teleg. cable	6,602
Rio Janeiro	64	Ostend	113
Rosario	858	Penang. Teleg. mat.	138
Rotterdam. Teleg. wire	29	Perth	222
Santa Cruz	35	Port Chalmers	109
Santos	134	Port Elizabeth	801
„ Teleg. mat.	190	Rotterdam	87
Stockholm. Teleg. wire	156	„ Teleg. mat.	45
Sydney	1,538	St. Petersburg. Teleg. mat.	225
„ Iron teleg. wire	204	„ Teleph. mat.	182
Trinidad	26	Seychelles. Teleg. instruments	11
Wellington	656	Sydney	914
Yokohama. Elec. cable	200	Valparaiso	81
„ Teleph. cable	780	Vancouver	19
		Wellington	108
		Yokohama	474
Total	£14,231	Total	£13,555

Foreign Goods Transhipped.

Durban. Telephones	£43	Barbadoes. Teleph apparatus	£54
New York. Elec. goods	450		
Total	£493	Total	£54

Bankruptcy Proceedings.—The first meeting of creditors was held on October 18th, at the London Bankruptcy Court, before Mr. G. W. Chapman, Official Receiver, under the failure of T. W. Greaves & Co., electrical engineers and cycle manufacturers, 230, East India Dock Road, Poplar, and 6, Nelson Street, Greenwich. The debtor (Greaves) states that he commenced business in 1895 as an electrician with a capital of £10. Two years later he removed to the present premises in the East India Dock Road, where the cycle business was added. Three months after that move, he was joined in partnership by a Mr. Ostermeyer, who introduced a capital of £150, and became entitled to one half of the profits. The business was carried on by them for about 12 months under the style of Greaves, Ostermeyer & Co. At the end of that period the partnership was dissolved, nothing being paid to Mr. Ostermeyer on his retirement. He (Greaves) subsequently carried on business alone up till January, 1898, when he took another shop at Nelson Street, Greenwich, which place he fitted up at a cost of £80. In December, 1899, he was joined in partnership by Mr. William George Randall, who brought in a capital of £125 in consideration of receiving one third interest in the business, which has since been carried on at both places as T. W. Greaves & Co. The accounts filed by the directors show liabilities £587 9s. 0d., against assets, stock, fixtures and machinery, £14; book debts £1 11s. 9d.; and other debts £26 6s. 9d., to which no value is attached. The reasons assigned for the failure are loss in respect of the business at Greenwich; sudden bad trade; the circulation of a damaging report and consequent stoppage of credit; bad debts; and immediately to pressure by creditors. The debtors filed their own petition on September 26th, and they were directed to attend the Court on November 15th for public examination. They were unable to submit any offer, and the creditors left the case in the hands of the Official Receiver to be wound up in the ordinary course of bankruptcy. Appended is a list of the principal creditors:—

	£	s.	d.
Unsecured—			
Sax, Slatter & Co., London	49	9	5
Millard Bros., London	140	0	0
Montague Gawnt & Co., London	38	0	0
Humber & Co., Limited, London	23	4	0
Gent & Co., London	16	17	8
Sheffield, A. J., London	15	18	7
Walter & Co., London	13	2	0
Veritys, Limited, London	15	18	1
Lang & Co., London	12	15	11
Dowuton & Co., London	11	14	4
Bowen & Co., London	13	7	3
Palmer Tyre Limited, Birmingham	21	0	0
Jenson, Messrs., Hampstead	20	0	0
Preferential—			
Rent	27	13	6
Rates and wages	12	17	5

Mr. B. S. Dunn's release as trustee in *re* E. L. Joseph, electrical engineer, of Brondesbury and Canonbury, dates from August 24th.

Belgium.—La Compagnie Internationale d'Electricité, of Liége, has recently established large new works for the manufacture of arc lamp carbons.

Dissolutions and Liquidations. — Creditors of the British Blahnik Arc Light Company, must send particulars of claims, &c., to W. H. Chantrey, 57, Moorgate Street, the liquidator, by November 24th.

Messrs. W. H. Chambers and G. A. Edwards (W. H. Chambers and Co., electrical engineers, 5, Milk Street, London), have dissolved partnership "pursuant to a declaration and order dated August 30th, 1900, made in an action in the City of London Court, Edwards *v.* Chambers, No. 338."

Liquidation Notice.—At the Bath County Court last week the Brush Electrical Engineering Company petitioned for the compulsory winding up of the Acetylene Light Syndicate, Limited. On October 1st the syndicate passed a resolution for voluntary liquidation. Deputy-Judge Hastings dismissed the petition.

Books Received. — "Flames, Electricity and the Camera," by George Iles. London: Grant Richards. 7s. 6d. net

"The Lead Storage Battery," by D. G. Fitzgerald. London: Biggs & Co. 7s. 6d.

The British Fire Prevention Committee.—The Executive of the British Fire Prevention Committee have decided to postpone the opening of their new testing station until after Christmas, as their testing operations are principally carried on in the spring and summer months, and many of the firms who wish to have tests undertaken prefer to avoid the winter weather for research work of this description. During the first part of the current session the Executive of the Committee will hence be mainly occupied in dealing with tests already undertaken in the summer, but in respect to which reports have not yet been issued. They will also be preparing an analysis of the tests undertaken to date, for which there appears to be considerable request. The offices of the Committee at Waterloo Place will again be available during the winter months as a reading room, and a file of over 60 technical journals from different parts of the world has been arranged for, whilst a small collection has also been formed in the reading room with a view to showing materials that have been subjected to tests.

Catalogues and Lists.—The General Electric Company, Limited, have issued an October sheet of certain ceiling roses, high voltage fuses, switches, and other accessories of a like character.

The Westinghouse Companies' Publishing Department have sent out Circular No. 1,032, which describes and illustrates in their usual excellent manner the Westinghouse No. 56 tramway motor. The various parts are shown by photograph and by sectional drawing, and notes of the construction, &c., are given.

The latest list of the British Thomson-Houston Company (No. 76) describes in some detail, with the aid of diagrammatic and photographic illustrations, the firm's rheostats for generators and motors.

The Société Française des Accumulateurs "Phénix," of Paris, who received a gold medal for their exhibit at the Paris Exhibition, have sent us a handy pocket booklet giving some descriptive notes of their "Phénix" batteries for various purposes.

The Compagnie Générale de Constructions Electriques, of Paris, were awarded a grand prize and two gold medals at the Paris Exhibition.

Messrs. Markt Bros. & Co., of Beech Street, Barbican, are circulating numerous illustrated price sheets of their electrical goods these including a variety of lampholders, ceiling roses, cut-outs, switches, wall pushes, electric light cables and cords, electric bells and bell fittings, indicators and accessories; also portable telephone sets and complete telephone stations, and electrical and magnetic toys. It is stated that the bulk of the goods particularised in these lists are manufactured by Messrs. Markt in England and abroad. Low prices are the special merit claimed.

Some tests of the relative efficiency of various non-conducting compositions were made at the London University College a few months ago by Prof. T. Hudson Beare. The experiments were carried out on the condensation of steam in steam pipes when uncovered, and when covered with a uniform thickness of 1½ inches of compositions. They were made for Messrs. Snowdon Sons & Co., of Millwall, and the results showed distinctly the best figures for this firm's composition. The experiments with Snowdon's material were made at four different boiler pressures, viz., 80, 45, 59, and 3 lbs. gauge pressure; that of five other makers was experimented with at only two pressures, viz., 80 and 45 lbs. The bags of Snowdon's composition were selected from stock at random by Prof. Beare's assistant, the others being bought in the ordinary way for covering steam pipes. A table of the results obtained and particulars of the apparatus employed are given in a pamphlet issued by Messrs. Snowdon, of which a copy is now before us. In a table the temperature of the steam given is the mean in each case of the observed results. The other compositions are arranged in this table in order of merit, beginning with the uncovered pipe, and finishing with the material which showed the least amount of condensation in the pipe. Another report printed in the same pamphlet is that of Mr. J. Zulauf, who conducted tests at St. Petersburg, on behalf of the Russian-American India-Rubber Works, and who also found most satisfactory results. Messrs. Snowdon's general catalogue is also before us. It contains particulars and illustrations of a large number of lubricators for use with "Snowdrift" lubricant. Several kinds of machinery oils, asbestos packing, sheeting, yarn, asbestos faced valves, cocks and such-like goods are detailed.

The Mica Lubricant Company, of South Shields, have forwarded

to us several lists of their specialities. These include their patent mica grease. It is asserted that 1 lb. of this grease is equal to 2 gallons of castor or 4 gallons of mineral lubricating oil, meaning that 1 cwt. of grease will do work equal to that done by 1 ton of castor or 2 tons of mineral oil. The "grease" is made in four consistencies to meet the various conditions and machinery. The "land" stuff is for land engines running at low speed; the "marine" is a little stiffer and is intended for warmer positions; "Indian" is for use in hot places in works, open bearings, and for tropical climates; the "cream grease" is for small machinery. The lists before us also describe their lubricators for employing this grease, and give particulars of their patent mica packings—non-conducting and self-lubricating—which are stated to have come through the most severe tests, in both high and low pressure cylinders, with excellent results. There accompanies these lists one from the Harbinger Elastic Metallic Packing Company, of the same address, citing the advantages claimed for the "Standard" patent automatic metallic packings, which are said to be suitable for any class of engines and not to necessitate any alterations to existing stuffing boxes. The packing rings are enclosed in a locked casing, which is in two halves, securely screwed together. The same applies to the spring holder and to all parts of the packing, therefore it can be taken out of the stuffing box at any time for examination without the possibility of parts being lost, or falling off the rods and becoming damaged. The packing is self-adjusting, and no other parts, but the packing casing floats to suit the movements of the rod. The packing rings are made of "Mica" anti-friction metals with a melting point of 550° F., which is well-suited for engines using superheating.

All who receive a copy of the 1900 album of Mr. Arthur Koppel, of Monument Street, E.C., will for a time find their attention fastened upon the very effective artistic production on the front cover. It represents the interior of an iron-works at night time when the operations are in full swing; the lurid glare of the brilliant fires lights up the darkness of the works in a very attractive manner, and the whole thing looks so realistic that one can almost hear the clatter of the workmen's tools as the forge and hammer render service. The view is seemingly one obtained at the Berlin works of Mr. Koppel, where portable and permanent railways and their parts are manufactured. The letterpress is printed in four languages, and the English introduction casts a backward glance upon the progress achieved in the department of field and factory railways, which have done so much to help the development of industry during the century which is now on the wane. So far as Mr. Koppel's efforts are concerned, these have consisted in the adoption of new contrivances, systems and methods, which should lead to greater economies in railway working, whether in the adoption of certain rail sections, the use of new clip-washers, the employment of pressed sheet metal for truck frames, the working of railways by electricity, or in saving tractive power by the employment of rollers. There is a highly promising future in store for all light railway stock and apparatus, but more particularly is that so in connection with electric traction. As to the contents of the album before us, these include views of works and plants constructed by Koppels. They show light railways adapted for use in the Norway heights for rock removal, harbour luggage transport in Denmark, a portable electric line on a Belgian hotel site, a railway on the East London waterworks, an electric trolley line for coal transport in France, an electric trolley railway for a Nederland beet sugar mill, and a large number of other similar electric and steam lines in various parts of the world, including Siberia, Syria, Africa, India, Australia, and America. The pictures are themselves of great interest from a general point of view, but to those who take an interest in the construction of light railways they are of particular service as showing the important work of this well-known firm.

Electric Cranes. — The Clayton Engineering and Electrical Company is to supply a 30 cwt. portable electric crane to the Southampton Harbour Board.

Electric Radiators.—The Prometheus Company, of Bockenheim, have for some time manufactured cooking apparatus and heaters of various descriptions which have met with great success both in this country and on the Continent, and their sole agents here, Messrs. O. Berend & Co., Limited, are continually introducing new patterns of cooking apparatus and new applications of the patents owned by the Prometheus Company. Under this company's patents the electrical energy is converted to heat through resistances formed of thin films of precious metals, such as gold, platinum, &c, deposited on an insulating base of mica, enamel or other suitable material. Resistances up to 25,000 ohms can thereby easily be obtained. The scope for the use of resistances of this description is practically unlimited where a heating effect is required, and those deposited on a mica base have lately been adopted for electric heating stoves or radiators. Although the use of electric energy for this class of heating has generally been considered too expensive, cases frequently arise where the advantage it affords far outweighs the question of cost, and where the cost of coal is high and electric energy can be obtained cheaply, radiators of this description can be used to advantage. There is also a large class of users of electric energy to whom the question of cost is of no importance if greater comfort and convenience can be obtained; thus a mansion at Frankfurt has now been fitted with these radiators throughout, and all other means of heating and warming abandoned. Electric stoves or radiators should be designed to act as quickly as possible, in other words, the amount of metal and other heat-absorbing material in connection with the resistances should be reduced to a minimum. In the stoves designed by the Prometheus Company this point has received great attention. A mica strip $5\frac{15}{16}$ inches × $1\frac{3}{16}$ inches × $\frac{4}{1000}$th inch thick, coated under the Prometheus patents with a film of precious metal, had a resistance of 120 ohms and at 110 volts absorbed 0·81 ampere or 89 watts; the mass or volume of the mica is, of course, extremely small, and the resistance radiates practically 76 calories per hour immediately. An average room of 3,531 cubic feet capacity requires some 2,000 to 2,500 calories per hour to warm it, and 30 of these resistances would therefore be required. The weight of the mica strip is practically *nil*, and the terminals or connections can be kept very light; the combination, therefore, absorbs but little heat and practically the whole of the energy is at once available. In practice, to ensure durability it is desirable that the temperature of the strips should not exceed 450° C., this corresponds to 70 to 75 watts per strip; at 90 to 100 watts the strips show dull red in the dark and oxidation would then occur. As stated above, resistances up to about 24,000 ohms can be obtained on a strip measuring $5\frac{15}{16}$ inches × $1\frac{3}{16}$ inches × $\frac{4}{1000}$th inch, and they can be connected in parallel in any number required to obtain the desired effect of the stove, and can be designed for any pressure of supply and for any temperature of the stove up to 400° C. The Prometheus stoves for these strips are circular, thus affording the greatest strength for the least weight, the number of strips employed depending on the size of the stove. The strips are mounted in two rows on a frame fitting into the circular case, the outer row therefore radiates heat direct, and a continual current of air passes up and is heated between the two rows. As each strip is independent and connected to the circuit in parallel, any one can be replaced or removed without altering any connections. The smallest pattern of stove contains 12 strips, weighs 5 lbs., and takes 6 to 8 amperes at 110 volts, the medium size contains 24 strips, weighs 10 lbs., and takes from 2 to 16 amperes at 110 volts, and the large size contains 48 strips and weighs 15 lbs. This and the medium size are fitted with the Prometheus regulator, enabling the stoves to be used from quarter to full power in four steps. Under ordinary conditions the small size radiators will be sufficient for heating rooms of from 700 to 900 cubic feet, the medium size for rooms of 1,400 to 1,800 cubic feet, the large size for rooms of 2,500 to 2,800 cubic feet capacity. To give the stove a cheerful appearance when working, a ruby lamp is arranged behind the mica strips and shines through and between them.

Garcke's Manual.—The fifth edition of this well known "Manual of Electrical Undertakings" will be published about November 1st next. It will contain general information and particulars relating to over 1,250 electrical undertakings including, where possible, copy of latest accounts and comparative tables showing progress. The number of pages has increased to about 1,300. The publishing offices are at Donington House, Norfolk Street, W.C.

For Sale.—Among our advertisements to-day are given some particulars of the electric fittings business of the Volt Electrical Company, Limited, of Birmingham, which is offered for sale as a going concern.

The Oldham Electric Light Committee invite offers for lead battery boxes, plates, and copper connections, containing about 22 tons lead and 1¼ tons pure copper. Offers stating the net prices per ton to be sent to Mr. Arthur Andrew, Superintendent, on or before Tuesday, November 6th.

Hub Motors.—An interesting innovation in the way of automobiles is about to be introduced in this country; a short demonstration of the system was given on Monday last, when a light two-passenger carriage was put through its paces on the Thames Embankment. The principal feature of the invention is the ingenious device of placing the motor *in the hub* of the driving wheels. The result is a remarkably light and graceful, and, we may add, mysterious vehicle—the motive agency being to the uninitiated an insoluble puzzle. As we hope to be in a position shortly to give full particulars and drawings of this remarkable type of automobile, we shall for the present merely add that the trial runs were entirely successful.

London County Council.—It was decided at the meeting on Tuesday to approve the accounts relating to the Council's tramways for the financial year ended March 31st, 1900. The accounts, after meeting expenditure, interest and sinking fund charges, left a balance of £54,847 for disposal—a result which the Highways Committee regarded as very satisfactory.

The Camberwell Generating Station.—The adjourned report of the Highways Committee reminded the Council that Section 28 of the London County Tramways Act, 1900, empowered the Council to acquire certain property adjoining the Camberwell tramway depôt as a site for the erection of a generating station. Since the passing of the Act it had been represented to the Committee that instead of acquiring some of that property, it would be more advantageous for the Council to purchase the premises of St. Matthew's girl's school adjoining the depôt in Camberwell New Road. On the recommendation of the Committee, it was decided to seek powers in the next session to acquire the school for that purpose.

Sliding Scale of Charges.—It will be remembered that last March the Council decided to make a representation to the Board of Trade, under the provisions of the orders granted to the Westminster Electric Supply Corporation, that the maximum price allowed to be charged by the company should be reduced from 8d. to 5d. per unit, and at the same time the Board was asked to hold an inquiry in relation to the matter. The Highways Committee now stated that an intimation had been received announcing that as the Board of Trade has under consideration the question of the imposition of a sliding scale of charges upon electric lighting companies in general, the Board proposed to defer taking action upon the Council's representation with regard to the charges of the Westminster Company.

of arc lamp carbons.

The Mica Lubricant Company, of South Shields, have forwarded

The Westminster Bridge Tramway.—The Parliamentary Committee reported that in considering the best method for giving effect to the 36 proposals for the construction of new tramways, they had had before them that for a line over Westminster Bridge. It appeared to the committee that the latter scheme might raise considerable opposition and so place difficulties in the way of the Council obtaining legislation to carry out the numerous other tramway proposals which otherwise might be to a large extent unopposed. After giving the matter careful consideration the Committee recommended that that particular scheme should be abandoned, and this was agreed to after discussion. The question of deciding to renew the application to Parliament for powers to reconstruct as a double line for electric traction the existing single line from Camberwell Green to Vauxhall was adjourned until next week.

Mansion Lighting.—The Alliance Electrical Company has recently completed an important installation for Dr. Rutherfoord Harris, M.P., at his country mansion, Llangibby Castle, Wales.

The Responsibilities of Electricity Supply Companies.—At West London Police Court this week an application was made to Mr. Rose for a summons against the Notting Hill Electric Light Company for failing to connect premises according to the Act. It appeared that a gentleman became the occupier of a house in Upper Phillimore Gardens, Kensington, and an application was made to the company to connect the premises. The company consented to the application, but on condition that the gentleman would sign an agreement to allow the premises to be disconnected if it were found that the plant was insufficient for the coming winter. To that an answer was given that the agreement was unreasonable, and there the matter remained, the company not connecting the premises.—Mr. Rose suggested that the company had not made default in the terms of the Act.—The applicant submitted that the company was bound to supply electricity without any agreement. The company might connect the premises one day and disconnect them on the next.—Mr. Rose said the applicant might take a summons to try the question.

The Telephonograph.—The presence of the Siamese Court Troupe at the Zoological Gardens in Berlin, has been seized upon by Profs. Stumpf and Neesen of the Berlin University, to make some interesting experiments in the study of the peculiarities of Siamese music. The professors hit upon the idea of employing the "Telephonograph," which was kindly lent by Messrs. Mix and Genest, Limited. With this apparatus (a description of which we have recently given), the musical effects were reproduced with such accuracy, distinctness, and graduation in the succession of sounds, that it was impossible to distinguish between the actual performance by the Court Theatre Troupe, and its reproduction on the "telephonograph."

Trade Announcement.—Messrs. W. Macdonald and Co., of 66, Finsbury Pavement, E.C., have been appointed London and South country agents for Mr. W. Rickard, of Derby. We are informed that Mr. Macdonald was for some time manager of Messrs. W. T. Glover & Co.'s Diatrine department at Salford, and after that joined the staff of Messrs. R. W. Blackwell & Co., Limited, assisting in the equipment of various tramway systems, including the Potteries, Norwich, and the Seaforth—Crosby tramway section of the Liverpool Overhead Railway Company.

Ward Leonard Apparatus.—The Ward Leonard Electric Company, of America, sends us a photograph of its "SU" type motor starting rheostat, having automatic "no voltage" release. The print shows the size furnished for ½ to 2 H.P. inclusive—125 and 250 volts, with slate front 6 inches × 6 inches. Another photograph received from the same company, shows a speed controller adapted for controlling a motor driving a printing press or for similar heavy duty in which the motor is to be started under heavy torque, and operated at various reduced speeds. The circuit is opened and closed by an independent, interlocking, double-acting snap switch provided with hammer blow feature. By this make-and-break switch, the burning of the contacts is almost entirely eliminated, making the controller especially adapted for continually starting and stopping the motor under conditions of full load. The switch contact parts are of very large surface for the current they are designed to carry, and every part is easily removable from the face of the switch. The controller is also provided with the makers' "DK" type circuit breaker, adjusted for opening at overload and also at failure of current on the line. A pair of binding terminals are provided for running circuit around press, for short circuiting the field (holding) magnet, by push buttons, thus opening the circuit in case it is desired to stop the press from some distant point. A third photograph, shows one of seven rheostats recently furnished to Messrs. D. Bruce Peebles & Co., of Leith, for starting a 100-H.P. 250-volt motor. The size of box is 22 inches × 28 inches × 6 inches deep. The resistance employed is German silver attached to the back of slate. The cast-iron box is then placed and sealed against the slate, and then filled with dry sand, completely surrounding the resistance strip for absorbing the heat generated during the period of starting. Among the good features claimed for this apparatus are the following:—

All wearing contact parts are of cast brass, made removable from the face of the front without disturbing any of the internal connections.

In the position of short circuit, the armature current has a short path through two terminal lugs, thus avoiding the possibility of heating of the switch pivot or contacts while in normal running position.

This instrument will stand for 15 seconds without injury, 100 per cent. more current than the normal torque of the motor.

The resistance being entirely enclosed, the possibility of molten metal setting fire in case of a burn out, is entirely eliminated.

The sole agents of the Ward Leonard apparatus for England and France are Messrs. Geipel & Lange, of Westminster, S.W.

ELECTRIC LIGHT AND POWER NOTES.

Abram.—The D.C. has resolved to apply for a prov. order for electricity supply.

Ashton-in-Makerfield.—The D.C. has decided to apply to the L.G.B. for a prov. order to supply electrical energy within its district.

Austria.—Electric lighting has recently been adopted in the Berlin-Karlsbad express by the Aussig-Teplitz railway authorities. A small dynamo, driven off one of the carriage axles, provides the current, not only for direct lighting, but also for charging a battery of accumulators, on to which the lighting circuit is switched when the train stops.

Barry.—The D.C. is considering the advisability of applying to the B. of T. for a prov. order for electric lighting purposes.

Basingstoke.—The T.C. has decided to engage Mr. R. P. Wilson, of Westminster, to report on an electric lighting scheme for the town, at a fee of 25 guineas.

Bournemouth.—Negotiations are in progress between the Bournemouth and Poole Electricity Supply Company, Limited, and the T.C. with regard to the purchase of the company's undertaking.

Brighton.—At the last meeting of the T.C. the Lighting Committee reported that they had decided that a letter be sent to all wiring contractors in the borough, informing them that electric motors exceeding 5 H.P. will be supplied at 460 volts. The Committee having been asked to again consider the question of applying for powers to wire consumers' premises, it was resolved that the General Purposes Committee be requested to include in the Bill, to be promoted next Session, power to enable the Council to wire consumers' premises through the medium of wiring contractors. On a division, however, the latter recommendation was rejected. An estimate was submitted of the further amount of capital which would be required for the purposes of the Corporation electricity undertaking during the years 1901-2. On the recommendation of the Lighting Committee it was resolved, *und vocc*, that application be made to the L.G.B. for sanction to borrow £56,500 for a period of 25 years. The estimate, which was prepared by Mr. Christie, included the following:—Two steam dynamos (500 KW. each) and switch gear, £15,000; one condenser, pumps and connections, £2,500; three boilers, pipes and accessories, £9,000; total, £26,500. New feeders, £11,500; new distributors, £5,000; house service and meters (1,000), £12,000; total, £28,500;—contingencies, £1,500;—grand total, £56,000.

Bristol.—Sir Benjamin Baker visited Bristol last week for the purpose of examining the site of the foundations of the Corporation's new electric works in St. Phillip's Marsh, in connection with the dispute which has arisen between the architect, Mr. H. J. Williams, and the engineer, Mr. Faraday Proctor, as to the necessity of certain strengthening supports for such a building. Sir Benjamin subsequently heard what Mr. H. J. Williams and Mr. Faraday Proctor had to say, and he will give his decision at an early date.

Calcutta.—Owing to the abnormal rains last month, a serious fault developed on the mains of the Calcutta Electric Supply Corporation, Limited, rendering it necessary to shut down the positive side of the lighting system. As the principal streets remained under water, the fault could not be remedied until the floods abated.

Colwyn Bay.—The D.C. has received so many applications for electricity supply that extensions are already under consideration, although the buildings have only just been completed.

Coventry.—On Tuesday last the E.L. Committee of the T.C. for the first time made a tour of inspection of the electricity works and sub-stations, escorted by the city electrical engineer, Mr. G. S. Ram. The total number of consumers is now 301, with 20,357 lamps.

Croydon.—The E.L. Committee of the County Council has raised the price of lighting by arc lamps from £18 to £21 per annum per lamp.

Dalkey.—At the last monthly meeting of the Dalkey (Co. Dublin) U.D.C. a letter from Messrs. Porte, Sykes & Co., Dublin, was read, advising the Council that it was their intention to apply to the Board of Trade for an electric lighting prov. order for the township of Dalkey. It was suggested that the D.C. should consider a proposal to establish a joint electric lighting scheme for the townships of Blackrock, Kingstown and Dalkey, and after some discussion it was resolved to refer the matter to the solicitor of the Council, who also was instructed to object to the prov. order referred to above.

Dartford.—On Friday Mr. H. P. Boulnois, M.Inst.C.E., held an inquiry on behalf of the L.G.B. into the application of the D.C. for sanction to borrow £20,000 for electric lighting purposes. There was considerable opposition from the ratepayers, who declared that the undertaking would not pay. Mr. Hawtayne explained the system to be adopted.

East Stonehouse.—Notice of the proposed transfer of the U.D.C's. provisional order to the Devonport Corporation appears in the *London Gazette*.

Eccles.—Col. J. T. Marsh, R.E., held an L.G.B. inquiry at Eccles on Thursday into the application of the Corporation to borrow £5,308 for purposes of electric lighting. It was stated that the electric lighting loan was for money already expended on necessary extensions of the main cable. There was no opposition.

Electric Lighting of Trains.—La Société Electricité et Hydraulique, of Charleroi, has secured a contract from the Belgian State Railway authorities to equip a large number of railway carriages with electric lighting on the Stone system.

Frome.—A special meeting of the U.D.C. was held last week for the purpose of further considering the reports of Mr. F. H. Medhurst, consulting engineer, as to the establishment of electric lighting works in the town, and a resolution was passed deciding to proceed with the matter and obtain the necessary prov. order.

Gainsborough.—Application is to be made to the B. of T. for a prov. order to supply electricity for all purposes within the urban district.

Hexham.—An adjourned meeting of the U.D.C. was held last week to consider the question of the supply of electric light to the town. It was resolved that the Council oppose the application of the Northern Counties Electricity Supply Company for a prov. order for the urban district, and that Messrs. Lacey, Clirehugh & Sillar be employed to prepare a preliminary scheme with a full report as to the best method of lighting the district of Hexham.

Leeds.—A report has just been issued by the Lighting Committee, giving a review of the work done during the year ended March 25th last. The *Leeds Mercury* says that the report points out that the period under review being the first complete year of the Corporation's ownership of the electric lighting undertaking, materials are not available for a tabulated comparison of results with those of previous years, but it might be said that the business has undergone considerable expansion since its acquisition by the Corporation. The number of consumers and the lamps, &c., installed, expressed in the equivalent of 8-c.p. lamps, were respectively as follows:—At March 25th, 1899, number of consumers, 980; at March 25th, 1900, 1,393; increase 413 (42·1 per cent.). Lamps installed at March 25th, 1899, 78,380; at March 25th, 1900, 106,263; increase 27,883 (35·5 per cent.). The units sold were 2,005,840; the revenue from this source, after provision for discounts and bad debts, was £34,156 1s. 11d., an average price of 4·09d. per unit. The average consumption of current per lamp was 21 units, yielding a revenue of 7s. 1·8d. per lamp. The capacity of the works had been increased during the year by the addition of a combined engine and alternator of 640 kw. (1,000 i.h.p.) with necessary boilers, pipes, &c., bringing the total capacity to 3,040 kw. (5,300 i.h.p.); and two similar sets remained on order at the close of the year. In addition to ordinary extensions of mains in various parts of the city, new trunk mains had been laid to Hunslet, and others are in progress for Chapeltown, Roundhay Road, and other districts. In view of the necessity for erecting extensions of the works on the site formerly occupied by Britannia Mills, the Committee took into consideration the question of the system of supply of electricity for lighting and motive power, and the manager of the department was instructed to make a tour in America to obtain information on the subject. A report was also obtained from Messrs. Hopkinson & Talbot, consulting engineers, and, in accordance with their advice, it had been decided that in future extensions of plant the two-phase alternating system should be adopted. Plans were being prepared for the development of the Britannia Mills site on these lines. The capital expenditure during the year was £75,006 11s. 7d., and the total capital expenditure to March 25th, 1900, was £307,520 3s. 3d., including £217,420 paid to the Yorkshire House-to-House Electricity Company, Limited, as purchase money for the undertaking as at August 31st, 1398. The total receipts on revenue account were £36,220 15s. 5d., and the working expenses were £9,929 10s. 10d. (1·19d. per unit sold), leaving a gross profit of £26,291 4s. 7d. After deducting interest (£12,473 5s. 10d.) and sinking fund charges (£5,316 0s. 2d.) a net profit remained of £8,501 18s. 7d. The total surplus on March 25th, 1900, was:—On capital suspense account, £3,785 4s. 2d.; on revenue account, £8,501 18s. 7d., giving a total of £12,287 2s. 9d. Of this amount, £4,000 has since been applied in relief of rates. The working expenses per unit sold (1·19d.) were the lowest recorded in the history of the undertaking for a complete year.

Limerick.—With reference to the inquiry held on July 11th by Mr. P. C. Cowen, L.G.B. inspector, in reference to the application of the Corporation for a loan of £22,000 to carry out a scheme of electric lighting in the borough, the L.G.B. for Ireland has intimated to the Corporation that the application is refused. Evidence was given at the inquiry to the effect that it was desirable to establish a system of electric lighting for the borough, and that there was a special reason for action by the Corporation, as a Bill was then before Parliament, the purpose of which was to enable a private company to generate electricity by water-power derived from the River Shannon, and supply it to the borough, thus creating competition with the lighting authority, the Corporation, who are the owners of the gasworks. The Bill in question, however, has been rejected by Parliament, so that the danger of competition referred to has been removed. As no other strong evidence was led in favour of the application, and as the rates are already 11s. 1d. in the £, while the finances of the T.C. are in an unsatisfactory condition, the Board has come to the decision stated above.

London.—The headquarters of the Honourable Artillery Company are being wired for electric light, and everything will be ready for the reception of the C.I.V. on Saturday. Some beautiful fittings have been designed for the spacious rooms in this well-known building, and the arms of the H.A.C. are being effectively worked in them. The contract is being carried out by Messrs. Dennison, Berlyn, Sillem & Co.

St. George's, Hanover Square.—The Vestry has made an agreement with the Westminster Electric Supply Corporation, Limited, for lighting the public thoroughfares of the parish with electricity. According to the *Times*, the installation is to consist, in the first place, of 600 arc lamps for continuous current of 500 or 750 watts as the Vestry may require, the posts to be of the same design as those already erected near Victoria Station. In places where arc lamps are not required incandescent lamps of 60 or 120 watts are to be fitted to existing gas brackets where necessary. The number of these will be comparatively small. The work is to be begun immediately, and to be completed, so far as the 600 arc lamps are concerned, by June 30th, 1902. The total cost of lighting the 42 miles of public ways contained in the parish is estimated at about £17,000 per annum, as compared with £11,000, the present cost of lighting with gas. For this additional expense the ratepayers will get from 15 to 20 times the amount of light which they enjoy at present. The agreement is to remain in force for 31 years, or until the undertaking is purchased by the local authority, whichever shall first happen, but after 10 and again after 20 years the local authority is entitled to refer to an arbitrator the question whether the payment per lamp per annum fixed by the agreement should be varied in consequence of any substantial alteration in the cost of lighting. The company is not to lose by any award which the arbitrator may make, but, on the other hand, any increase of profit may be apportioned between the company and the local authority in such manner as the arbitrator may think fit to award. The annual cost of each lamp will be:—750 watts arc lamps, £32; 500 watts ditto, £22; 120 watts incandescent lamp, £4; 60 watts ditto, £3; these rates to be subject to a cumulative rebate of ¼ per cent. per annum for each year after the first full year during which any lamp has been used.

Whitechapel.—The Electrical Committee of the District Board of Works has given notice of a great reduction in the price of current supplied to users of motors, during the hours before the lighting of the streets is commenced.

Marylebone.—On Tuesday evening a special meeting of the members of the St. Marylebone Vestry was held, Mr. T. H. Brooke-Hitchings presiding, for the purpose of resuming the adjourned debate on the motion of Mr. E. White:—That the Vestry now confirm that part of the Minutes of Thursday, August 2nd, 1900, which related to the proposed purchase of the Marylebone undertaking of the Metropolitan Electric Supply Company, and which empowered the advisory Special E.L. Committee to conclude negotiations with the company for the transfer of its undertaking under the (West London and Marylebone) Electric Lighting Order as embodied in the provisional agreement dated June 25th, 1900. The price proposed to be paid by the Vestry for the undertaking was £916,000. The discussion was a lengthy one, occupying the attention of the Vestry for over three hours. Messrs. Dunn, Paxton, W. Sutherland, J. Anglim, and others, spoke strongly in favour of the delegation's recommendation being adopted, while Sir Edwin Galsworthy, Mr. G. R. H. Stringer, Mr. M. Morris, and others, spoke in opposition, and urged that such an important matter should have been left to the new Borough Council to deal with. It was contended also that the price asked was far above what ought to be paid. The company required £500,000 for the goodwill, and in less than 40 years the Vestry would have the undertaking without having to pay anything for goodwill. On the question being put to the vote, the non-confirmation was carried by 31 to 26. The scheme proposed by the Special Committee therefore falls through.

Rotherhithe.—The Vestry has refused to consent to the County of London and Brush Provincial Electric Lighting Company, Limited, applying for a prov. order for the supply of electricity in the parish.

Last Friday's *London Gazette* contains the following notice:—

North Metropolitan Electric Power Supply.
63 and 64 Vict.—Session 1900.

Notice is hereby given that, subject to and in accordance with the provisions of the North Metropolitan Electric Power Supply Act, 1900, the necessary arrangements are being made for the supply of electricity (*a*) to the authority for lighting streets, bridges, or public places; (*b*) to all local authorities, persons, or companies being authorised undertakers under statutory powers within the districts of the Poor Law Unions of Hendon, Barnet, Edmonton, Ware, Hertford, Welwyn, St. Albans, and Chingford.

Dated this 16th day of October, 1900.

By order,
Geo. J. Somerville, *Secretary*, Surrey House, Victoria Embankment, London, W.C.

Malton.—At a special meeting of the Norton (Malton) U.D.C. last week to consider the terms of the agreement with the Northern Counties Electric Supply Association, who desired the Council's consent to their application to the B. of T. for a prov. order to supply electricity within the district, the Council approved of the signing of an agreement by which the association undertakes to light the district with electricity at a price 30 per cent. less than is paid for gas; to establish works in the district within two years of obtaining an order; not to charge more than 7d. per unit to private consumers; and to sell the works to the Council, if desired, at the end of 12 years.

France are Messrs. Geipel & Lange, of Westminster, S.W.

system to be adopted.

Melksham.—For £30 the D.C. has granted a 21 years' license to a company to supply electricity.

Newport (Mon.).—The T.C. has decided to apply to the L.G.B. for sanction to borrow £30,000, repayable within 25 years, for electric lighting purposes; £10,000 of the sum has already been spent.

North Metropolitan Area.—The Finchley D.C. has withdrawn from the association of local authorities.

Paisley.—A report, made up by the burgh auditor, Mr. Balderston Whyte, to which we briefly alluded last week, has just been submitted to the Paisley Town Council, and will form the subject of a special meeting to be held soon. Mr. Whyte points out that the original estimates have been exceeded to a most extraordinary extent. He says, however, that it is hardly within his province to say whether this expenditure has been excessive or not. He could see from the accounts paid that a very large part of the extra expenditure could not have been foreseen or avoided. Three-fourths of the amounts paid by certificate were not, he found, confirmed in any way by the minutes. The following are the chief items of expenditure :—

—	Original estimate.	Accepted tenders.	Cost to date.
Buildings	£5,500	£11 668 17 1	£20,562 9 7½
Machinery and plant	£18,200	£28,573 9 6	£34,277 19 5
Mains, cables, &c.	£5,050	£9,859 17 6	over £40,000
Transformers and sub-stations ..	£1,100	£2,548 8 0	£9,416 17 11½

Arc lamps, pillars, &c., also show an excess over original estimates. The report states that on December 24th, 1896, the estimated cost of the works was £33,750 for 10,000 lights, or £65 10s. per KW. Taking the capital expended at £95,000, and capacity at 1,100 KW., the cost of the works comes out about £86 per KW. But extensions in mains still to be made to utilise reserve current will probably make the cost about £90 to £95 per KW. Altogether up to date, an excess of £14,000 has been expended over the borrowing powers.

Pateley Bridge.—A public meeting was held at Pateley Bridge on Friday evening to consider the advisability of supplying the town with electric light. Mr. Harrison, of Ripon, explained at some length a scheme for lighting the town. He stated that he had examined the water-power at the Pateley Mills, and found that after working hours 35 H.P. was running continually to waste, and this might be utilised. The probable initial cost would be under £2,000. The meeting passed a resolution in favour of electric lighting.

Pontefract.—The question of electric lighting has for some time been before the various authorities of the Pontefract district, and, according to the *Leeds Mercury*, a scheme has now been placed on foot by which one power station would supply energy for electric lighting, tramways, and power for industrial concerns for Pontefract, Featherstone, Castleford, and Knottingley. The company (a London syndicate) propose, if the various authorities will agree, to run tramways through the places named at 1d. per mile, with ½d. per mile workmen's cars. Electric light they propose to supply at 5d. per unit for private lighting, 4d. per unit for public, and 4d. for the first hour and 1d per unit for each succeeding hour for power purposes. The syndicate, through their local engineers, Messrs. Richardson & Le Maitre, will shortly issue a circular to the authorities concerned, and with this end in view, their representatives have been surveying the district.

The Pontefract D.C., on Saturday last, favourably considered a similar scheme to include Fryston, Glass Houghton, Brotherton, and Ferrybridge, in a combined district, to be supplied from one station with electrical energy for lighting purposes and tramways. The Council adjourned the discussion a month, asking the engineers, Messrs. Richardson & Le Maitre, to attend and explain the details of the scheme.

Portmadoc.—The D.C. has decided to support a private syndicate in an application for a light railway order for a line from Portmadoc to Beddgelert and in applying for an electric light prov. order for the district.

Rosario.—The *Review of the River Plate* says that the River Plate Electric Light and Traction Company has prepared the plans and estimates for putting its installation in Rosario in order, in accordance with the decision of the Arbitration Court. The work will cost £95,000. The actual system of alternating current is to be changed to continuous current. All the mains in the central streets will be underground.

Royton.—The D.C. has unanimously passed resolutions in favour of obtaining prov. orders for the supply of electricity for all purposes within the district, and for the construction and maintenance of new tramways in the district. The Council has appointed Mr. R. P. Wilson, of Westminster, as its engineer. Notice of motion was also given for the formation of a tramway committee.

Stroud.—At a special meeting of the U.D.C. last week it was decided to oppose the granting of a prov. order to any private company for the supply of electric light within the Council's area, on the ground that the Council contemplated doing the work itself.

Torquay.—The electricity accounts show that for the year ended last March the electricity works cost £2,425, and yielded a revenue of £3,277, or a profit of £852. Interest and redemption on the debt came to £1,188. Allowing for everything there was thus in the second year of working a deficit of only £336, a result that is highly gratifying.

Windsor.—The U.D.C. has received notice from the Windsor Electrical Installation Company, Limited, that as they cannot see their way to accept the clauses insisted on by the U.D.C., they have decided to abandon the application for a provisional order for the lighting of Clewer Without.

Wisbech.—The Corporation give notice in the *London Gazette* of their intention to apply for a provisional order.

Worcester.—The City Council has approved a proposal to build an additional electricity generating station, mainly because of the prospective demands of electric tramways which the Council has undertaken to supply. The Council has decided that it is inexpedient to extend the Powick station, where the water-power of the Tame has been employed partially to meet the demands of the city, and will acquire a site in the city near the Severn at a cost of £4,450 for the purposes of a new station. It was estimated that a city station would cost £33,000, and an extension of the Powick station, £47,000.

The 12 months' leave of absence granted by the Worcester City Council to Mr. Sutherland, electrical engineer, on account of ill health, having expired, it was medically reported that he was able to return to business, but that an extension of leave would be beneficial. The Council, therefore, decided to extend the leave of absence for two months, Mr. E. E. Hoadley remaining in office as acting engineer with Mr. Sutherland as consulting engineer.

Worksop.—The U.D.C. is making application to the Public Works Loan Commissioners for sanction to borrow £15,575 (repayable in 25 years) for electric lighting works.

ELECTRIC TRACTION NOTES.

Birmingham.—The Corporation has decided to appoint a Tramways Committee to take over the management of tramway affairs from the Public Works Committee.

Brighton.—The T.C. at the last meeting had under consideration a report from the Tramways Committee upon the tenders received for the supply and delivery of 2,000 tons of steel girder tramrails, including curve rails, 78 tons of steel fishplates, and 90 tons of steel joists, and 25 electric motor cars (in three sections). The Committee recommended that the tender of Messrs. Bolckow, Vaughan & Co. for tramrails, fishplates, and steel joists for the sum of £18,397 be accepted, and that the tender of the British Westinghouse Company to supply and deliver 25 electric motor car bodies, 25 electric motor car trucks, and 25 electric motor car electrical equipments, in accordance with the terms of the specification prepared by the engineer (except that each car shall be constructed to carry 50 passengers instead of 57), at the price of £619 10s. for each complete car, total £15,487 10s., be accepted, and that the Law Guarantee & Trust Society, Limited, be accepted as surety for the due performance of the contract by the British Westinghouse Company. An amendment was proposed, that the tender of the Westfalisch Stahlwerkes, of Bochum, Westphalia, for £16,975 18s., be accepted, it being remarked that the only reason for the Committee's recommendation was that the rails, if the lower tender were accepted, would be made in Germany. It was urged that it would be grossly unjust to throw away £1,422 of the ratepayers' money on "cheap patriotism." It was stated, however, that the engineer's report had largely influenced the Committee in their decision, and that while Messrs. Bolckow, Vaughan & Co. were prepared to supply within two months, it would take three months to get the rails from the German firm. The Committee's recommendation was adopted, with only one dissentient. In moving the acceptance of the British Westinghouse Company's tender for the tramcars, Alderman Sendall stated that when the Committee were at Liverpool they saw the 50-passenger car running, and the general manager there expressed his opinion that it was the best car yet produced. The proposal was carried unanimously.

Bristol.—The new central power house of the Bristol Tramway Company is now nearly complete, and the fine depôt at Brislington is being rapidly pushed forward. This depôt covers five acres of ground, and includes a huge running shed to house 84 30-feet cars at once, another fine shed of equal size for painting and manufacturing cars, and an electrical fitting shop, where each car will be overhauled once a month and its fittings tested. Electric traction is much more destructive to the wheels than horse traction, and renewals have to be frequently made. The workshops are to be filled with all the necessary machine tools, electrically driven by a number of small motors, served with current from the general power house two miles away.

Bulgaria.—The finishing touches are being put to the system of electric tramways which has been constructed in the city of Sofia by La Société Électricité et Hydraulique, of Charleroi, Belgium. The lines are to be opened for traffic at an early date.

Cradley, Netherton.—Our local correspondent writes :—"After a fortnight's suspension of traffic on this new electric line the service was reopened on Friday, much to the convenience of the public. The weak part—that of brake power—has been remedied satisfactorily by more powerful brakes being used."

the owners of the gasworks. The Bill in question, however, has been rejected by Parliament, so that the danger of competition referred to has been removed. As no other strong evidence was led in favour of obtaining an order; not to charge more than 7d. per unit to private consumers; and to sell the works to the Council, if desired, at the end of 12 years.

Falkirk.—In regard to the proposed electric tramways for Falkirk, Dean of Guild Miller explained at the meeting of the Town Council on Monday evening that the heads of the agreement between the Commissioners and the company who proposed to run the tramways were as follows:—That the company pay £100 per mile per annum for maintenance and upkeep for five years, and that at the end of five years the sum be increased to £120 per mile annually. The company have also undertaken to causeway the roadway between the rails and 18 inches on either side to the satisfaction of the Commissioners, and the latter have the option of purchasing the undertaking at 25, 30, or 37 years. The agreement was considered very satisfactory by the Council.

Hull.—At the last meeting of the Works Committee of the Corporation the electrical engineer presented a report with reference to recent breakdowns on the electric tramways. He said that the breakdowns were not in excess of those occurring at other places, when the quick service in Hull was considered. They had seven miles of track in use, and there were something like 15,100 car miles run each week. Each fixture on the overhead wire had 2,157 trolleys running over it every week, and therefore the wear and tear must be enormous. He suggested the employment of extra fitters and labourers to keep the plant in good condition. The report was adopted.

Kidderminster.—The Earl of Jersey and Colonel Boughey held a Light Railway inquiry on 17th inst. at Kidderminster, relative to the application of the Kidderminster and Stourport Electric Tramway Company for powers to construct a line from Kidderminster to Bewdley, with a branch to Franche. Mr. Morse appeared for the promoters, and in opening the case said they were already largely interested in the district, and were rendering public service to it. The railway they now proposed to construct would be 4 miles 3 furlongs long, running from Kidderminster to Bewdley, and Kidderminster to Franche. The motive power would be electric, as on the line to Stourport. The company came before the Commissioners first of all with the assent of the Corporation of Kidderminster, who stipulated that though the line was carried through the Bull Ring it should not be used for ordinary passenger traffic, but only to take empty cars backwards and forwards for use on the line. The promoters also had the support of the Bewdley Corporation. The Kidderminster Rural District Council favoured the proposed construction, but signified they did not give their approval to any detail. The Worcestershire County Council opposed on certain points. Mr. W. R. P. Hederstedt, C.E. (representing Mr. Stephen Sellon, C.E.), gave evidence as to the plans put before the Commissioners. Considering the gauge of the railway, he did not consider the road too narrow for the line. The spot proposed by the County Council for the terminus was not a convenient one. As to the passage over Bewdley Bridge, the company proposed to construct a double line.

Kingston-upon-Thames.—The Corporation devoted the whole of Tuesday evening to the discussion of tramway proposals, and ultimately adopted, by 25 votes to 5, the following recommendations of the Tramways Committee:—

(*a*) To promote a Bill in Parliament for the construction, working, and leasing of the following lines of tramways, to be worked by electricity:—

1. From the borough boundary at Surbiton, along Portsmouth Road, skirting the Market Place, and along London Road to Kingston Hill, and a short branch connecting with Coombe.
2. A connection with No. 1, proceeding over Kingston Bridge to a junction with the United Tramways' proposed system at Hampton Wick.
3. A connection with No. 1 along Richmond Road to Ham boundary.
4. A connection with No. 1 at Norbiton, along Park Road to near Richmon d Park.
5. A similar connection towards the Malden boundary.
6. A short line along the Fairfield Recreation Ground.
7. A line from near the Market Place to the Surbiton boundary (in connection with the Surbiton District Council's suggested scheme to reach Surbiton railway station).

7A. The aforesaid connection with Surbiton railway station in the Surbiton district.

(*b*) To oppose a Bill promoted by the London United Tramways, Limited, for a system of tramways in the borough.

(*c*) To charge the expenses of the promotion and opposition to the borough fund and borough rate.

The Town Council having been extensively criticised on account of their uncompromising refusal to negotiate with the United Tramways Company, Councillor Lyne, the chairman of the committee, produced correspondence from Mr. Clifton Robinson, showing that that gentleman himself recognised on a previous occasion that the proper time to negotiate was after the Corporation had obtained tramway powers, but Mr. Robinson now expressed his readiness to discuss the company's own scheme verbally with the committee. The committee also supplied a lengthy tabulated list of answers concerning municipal tramways from the town clerks of 39 towns, showing that in 36 cases the respective Corporations either owned the systems, or were about to do so. In 24 cases the Corporations worked their tramways, and in 13 instances had leased them to companies. Details were also supplied as to the mileage, cost, expenses, and profits. Mr. J. Edward Waller, M.Inst.C.E (of Messrs. Kincaid, Waller & Manville), having been consulted with regard to the Corporation's scheme, reported on both the question of ownership and the routes suggested. In view, he wrote, of the number of proposals for tramway systems affecting Kingston, it would not be politic to look on the Council's scheme as an isolated local line, for without doubt tramways would be laid down in adjoining districts. It was undesirable, however, for the Corporation to enter into negotiations with any promoters of tramway schemes, for there was no reason to anticipate that any particular scheme would be successful. If Kingston consented to a comprehensive scheme affecting Kingston, and the application failed, either the town would be left without tramways, or else the company would construct only the local portion of the scheme. Mr. Waller concluded thus:—

> Kingston is the key to the whole position, and as such, is of essential value in connection with any adjoining system. . . . . If you retain this key, you will be able to make much better terms than you could possibly expect were you now to enter into negotiations with the one company who for the moment is in the field. I do not recommend a policy of isolation, but it is of the utmost importance that the Corporation should be the owners of the system in the borough, and be in a position to enter into agreements in respect to running power over their lines with any companies that have, or may obtain, powers in adjoining districts. The Corporation should obtain powers to work the tramways themselves, but it is premature to consider how far such powers would ultimately be exercised.

Liverpool.—On Sunday last the new electric tram route between the Pier Head and West Derby village, Liverpool, was opened for traffic. The opening of this route cleared away the last of the old horse cars from the streets of Liverpool. The length of the West Derby route is a little over 4¼ miles, with an alternative route in the city of about 4¾ miles. The full through fare is 2d. in or out, and there are 1d. stages for about half the distance from either terminus and intermediate 1d. stages. Of Liverpool's municipal debt £1,000,000 is now on account of electric lighting and £1,400,000 on account of electric tramways.

The Health Committee of the Corporation of Liverpool have approved of a report by Mr. J. A. Brodie, city engineer, proposing to give a number of the principal gangers in each of the tramway gangs two week's holiday with full pay as a reward for the manner in which they have done their duty during the great pressure consequent on the hurried completion of the electric tramway system.

There was half-an-hour's block in the electric car service near Pierhead terminus on 16th inst. through the fall of the down wire.

Llandudno.—The Town Council last week resolved to appoint a committee to consider the question of the advisability of constructing an electric tramway round the Great Orme's Head.

Newport (Mon.).—The Lighting and Traffic Committee have decided to recommend the Council to work the cars on the new electric tramway now in course of construction on Corporation Road directly under the control of the Corporation, and not to lease the line to a company. The existing lines are at present leased out, but the lease expires shortly.

Oldham.—Last week Mr. A. P. Trotter conducted a Board of Trade inquiry into the application of the Corporation to borrow £280,000 for tramway purposes and electrical equipment. The town clerk explained that the Corporation were under an obligation to complete a small length in Middleton Road on or before December 15th next, and this was brought about because the British Electric Traction Company tried several times to come into the borough. £71,000 was required for purchasing and laying down the lines only, and not for equipment.

Paisley.—The T.C. met this week to consider the various offers in connection with the new electric tramways for the burgh and district. The town clerk stated that since last meeting he had received a letter from Messrs. Atherton, of Liverpool, stating they were prepared to take £7,000 of Corporation stock, yielding 3¼ per cent., this amount to be lodged with the Corporation as security for Messrs. Atherton's carrying out of the work for which they had offered. Ex-Provost Clark said he was astonished at the liberality of their offer, but pointed out that Messrs. Atherton would only be liable to the extent of their rolling stock. Bailie Bell, seconded by Mr. Kent, moved that steps should be taken to meet with various offerers for leasing, and to confer with outside authorities. Further consideration, however, of the matter was adjourned till 29th inst.

Salford.—The Tramways Committee has reported to the Council regarding the arrangements which has been made with the Manchester Corporation with reference to the working of the present Salford trams to their termini within the city. The general particulars of the agreement are published in the *Manchester Courier* for October 18th. Among other things it is agreed that the Manchester Corporation shall provide and maintain at their own expense the permanent way and the electrical equipment thereof, and supply the necessary electrical energy for working the tramways; the Salford Corporation to pay to the Manchester Corporation the charge for electrical energy supplied for the working of the Salford cars, such charge to be the same as that made by the Manchester Electricity Committee to the Manchester Tramways Committee, provided always that such charge shall not exceed that made by the Salford Electricity Committee to the Salford Tramways Committee. The Salford Corporation are to provide and maintain at their own expense the permanent way and the electrical equipment thereof, and to supply the necessary electrical energy for working the tramways. The Manchester Corporation were to pay to the Salford Corporation the charge for electrical energy supplied for the working of the Manchester cars, such charge to be the same as that made by the Salford Electricity Committee to the Salford Tramways Committee, provided always that such charge should no exceed that made by the Manchester Electricity Committee to the Manchester Tramways Committee.

Taunton.—At a special meeting of the T.C. on Monday morning the Streets and Highways and Electric Lighting Joint Committees reported that they had received a communication from the British Electric Traction Company, intimating that that company had arranged to take over from the local company the Taunton Tramways Order, 1900, and to at once start the work of laying the tramways if the Council would consent to the company (1) abandoning the proposed tramway in St. James's Street and substituting a line in Gray's Road and along Blake Street as an approach to the company's proposed depôt; (2) substituting tar macadam for wood blocks between the rails. The Committees considered the proposed variations in consultation with the company's engineer, and they recommended the Council to consent to the company's first request. As to the second request, they recommended the Council to require a single line of setts (duly toothed) to be laid on either side of the rails, and the space between the metals to be made up with macadam except opposite and for a sufficient distance on either side of the hospital, where wood blocks should be used. The Committee's recommendations provoked a long and animated discussion, but they were in the end agreed to by a majority of 17 to 3. The Electric Lighting Committee then reported as follows:—

The British Electric Traction Company having applied to the Council to supply electric power for the company's proposed trams in the borough, your Committee have ascertained that the company would be prepared to agree to the following terms:—Terms of supply of electrical energy: For any quantity up to 60,000 units per annum, 2d. per unit. For any excess quantity up to 120,000 units per annum, 1½d. per unit. For any excess quantity from this figure up to 180,000 units per annum, 1½d. per unit Guarantee by the company to take or pay for 60,000 units per annum, also that if the company cease to work within seven years they will pay one half of the cost of laying down plant. Your Committee present the following estimate of the cost of the plant which the Council would have to lay down for the purpose of supplying current to the company:—

75 KW. direct current generator	£600
75 KW. ditto engine and generator	1,200
Alterations and additions to Willans engine	200
88 KW. motor alternator	370
Switchboard and cables	800
Foundations and trenchings	75
Steam and exhaust piping	175
Contingencies	150
Engineers' fees, &c.	150
Total	£3,920

Your Committee recommend the Council to enter into the before-mentioned arrangement with the British Traction Company, and to authorise your Committee—on the due execution of an agreement embodying the said terms—to obtain tenders for and proceed with the laying down of the said plant. Your Committee recommend the Council to apply to the Local Government Board to sanction the raising by the Corporation of a loan of £3,250 to be expended on plant according to the above estimate.

This report was unanimously adopted.

Wigan.—The construction of the electrical tramways system is being pushed on rapidly. The Committee responsible for the work have decided to ask permission to extend the line into the Standish and Aspull districts.

TELEGRAPH AND TELEPHONE NOTES.

Cardiff Telephones.—The Parliamentary Committee received a letter from the General Post Office stating that, the Council having decided not to establish a municipal telephone exchange, the department had decided to take immediate steps to popularise the Post Office telephone in the town.

"Free Trade" and Telegraphy.—In an interesting contribution by Lady Dorothy Nevill to the *Anglo-Saxon Review*, headed "Some Letters and Recollections," a letter from Cobden is given. This letter, written more than 40 years ago, may help us to an understanding of how the newly-gained advantages of submarine telegraphy were appreciated at that time. What, in those days, was a marvel to be admired, would now appear to have dwindled to a commonplace. The following is an extract from the letter referred to:—

Dunford, August 6th, 1858.

Dear Lady Dorothy,

. . . . What a glorious piece of news we have in the completion of the Atlantic cable! A message may now be sent to America in less than no time, beating the sun by several hours. When the old Greeks invented Phœbus at the risk of their mythology, they never dreamed of anything half so grand as this. . . .

I remain, very truly yours,
R. C.

Municipal Telephony.—The Association of Municipal Corporations had this matter before them at their meeting held in London on Tuesday. The Mayor of Huddersfield moved that the report adopted at a conference of corporations interested in the telephone question be received and entered on the minutes. It was stated in the report (says the *Times*) that Sir J. Woodhouse, M.P., and Mr. Southern, of Manchester, had had an interview with Mr. Hanbury, who had informed them that the proposal for a postponement of interest and sinking fund charges for a period of three years was a very important one and would receive fair consideration at his hands; that if the Government acquired the municipal plant at the termination of the license they would acquire it at a price, and the money paid would furnish the means for paying off the capital borrowed. Mr. Hanbury said he was under the impression that the Treasury minute already provided for this, but that, if it did not, there was no reason, as far as he could see, why it should not. The right hon. gentleman added that he could hold out no prospect at present of the withdrawal or modification of the royalty of 10 per cent. on the gross receipts. The conference therefore recommended municipalities contemplating the establishment of a system of municipal telephones to apply for licenses to expire in 1911, unless there were special or local circumstances rendering a longer license desirable. Mr. L. C. Evans (town clerk of Salford) seconded the motion, which, after a short discussion, was agreed to.

Rome-Paris Telephone.—The *Morning Post* Rome correspondent says that during the whole of last summer the work was actively pushed forward for the completion of the telephone line between Paris and Rome. On the Italian Alps alone the supports for the line cost £30,000. At present the wires are being laid between Turin, Novi, and Genoa. It is expected that the line will be in working order by next summer.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
South American:—		
Pará-Maranham	March 1, 1900	..
Ceará-Maranham	Feb. 20, 1900	..
Paramaribo-Cayenne	Oct. 6, 1900	..
West Indies:—		
Mole St. Nicholas-Cape Haitien	March 6, 1900	..
African:—		
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	..
Zanzibar-Mombassa	Sept. 29, 1900	..
Latakia-Cyprus	June 20, 1899	..
St. Jacques-Thuanan Hué	Oct. 28, 1900	..
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	..
Pekin-Kalgan	June 14, 1900	..
Kalgan-Maimatchin	June 30, 1900	..
Tientsin, *via* Shanghai	June 16, 1900	..
Tientsin-Niuchwang	June 18, 1900	..
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 22, 1900	..
Ecuador landlines	March 18, 1897	..
Landlines south of Serena	July 30, 1900	..
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	..
Moulmein-Bangkok	Oct. 15, 1900	Oct. 17, 1900.
Majunga-Tananarive	Oct. 20, 1900	Oct. 21, 1900.
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	..
Communications between Saigon and North Annam and Tonkin	Oct. 23, 1900	..

CONTRACTS OPEN AND CLOSED.

OPEN.

Ayr.—November 1st. The Council is inviting designs, specifications, and tenders for electric tramway cars, with trucks and complete electrical equipments. Specifications from Mr. John Young, Corporation engineer, Town Buildings, Ayr, on deposit of £1.

Balearic Islands (Spain).—October 30th. The municipal authorities of Palma (Balearic Islands), are inviting tenders until the 30th inst., for the electric lighting of the public streets of the town, by means of 60 arc lamps. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamento de Palma (Balearic Islands).

Belfast.—November 23rd. Tenders are invited for steam pipes, pumps, condensing plant, boilers, mechanical stokers, superheaters, coal and ash conveying plant, and switchboard extensions for the Corporation electricity works. See "Official Notices" October 12th.

Cuba.—October 26th. The municipality of Cienfuegos is inviting tenders for a service of public electric lighting for the town. All inquiries and tenders to be sent to the Secretary's Office in Cienfuegos, Cuba.

Glasgow.—The Glasgow International Exhibition (1901) Executive Council invites tenders for the erection of the wiring for arc and incandescent lighting, and electric motors. The main cables, arc lamp cables, arc lamps, incandescent lamps, &c., will be supplied to the contractor, who must take delivery thereof and erect same. Particulars on application to Mr. Thomas Young, the engineer, 4, West Regent Street, Glasgow.

Grantown-on-Spey.—November 6th. The Commissioners invite tenders from electric light companies to supply electric light for public and private consumption within the burgh, stating highest price charged consumer, and terms for future purchase by burgh.—W. Forsyth, Town Clerk.

Ilford.—November 12th. The U.D.C. invite tenders for free wiring. See "Official Notices" to-day.

Lincoln.—November 15th. The Corporation wants tenders for a dryback marine-type boiler; a high speed engine coupled to a C.C. dynamo; pump and motor and accessories.

London.—November 10th. The Streets Committee of the Corporation wants to hire a mechanically driven dust cart. See "Official Notices" October 5th.

(*Continued on page* 673.)

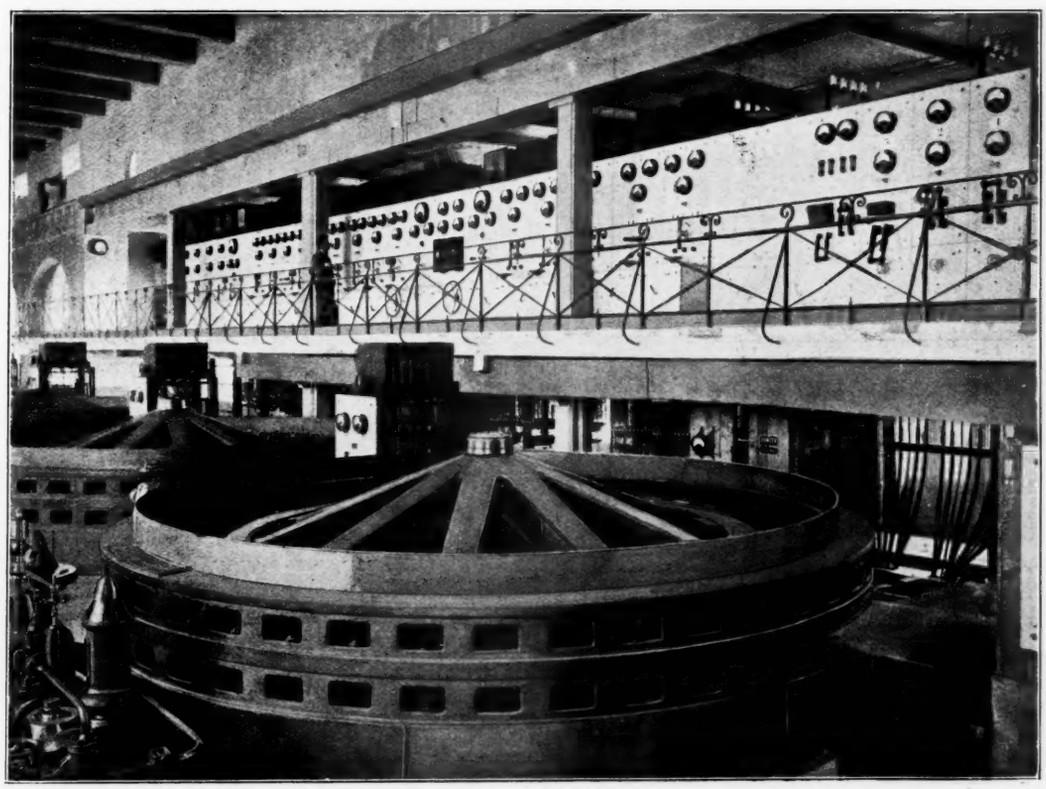
THE ELECTRICITY WORKS OF CHÈVRES (GENEVA).

(*Continued from page* 591.)

Sets 6 to 15.—These 10 similar sets (fig. 4) are principally distinguished from the first five sets by the method in which the water is brought to the turbines. Whilst the fall acts on the turbines externally in the first five sets, it acts internally on them in the new arrangement, giving them a centrifugal motion; this reversal of the part played by the fall permits of obtaining a considerably higher number of revolutions.

Each group of new turbines consists, as in the case of the older ones, of two superimposed turbines, each one having two rows of motor blades and two rows of guide blades. The rows of guide blades, or distributors, are fixed on bearing rings held in concrete. The two three pieces, connected together by strong couplings. It runs in four bearings, the lowest, or step bearing, fixed in the masonry, two intermediate bearings, and one top bearing. The two rows of blades of the motor wheels are bolted on to an annular boss, which allows the counter-pressure developed underneath to completely balance the weight of the turbine. It has been possible, by this means, to concentrate the weight of the armature of the alternator on a ring bearing, without having recourse to any artificial balancing. This arrangement, which presents important advantages over the oil-pressure bearings of sets 1 to 5, has, up till now, been very satisfactory.

The regulation of the turbines is effected by means of sliding rings with a vertical movement, placed outside the motor wheels. A regulating mechanism placed centrally around the ring-bearing connects the rings with the automatic oil-pressure regulator. Each turbine can be isolated



Brown Two-phase Alternators, of 1,200 h.p. each. (Nos. 6 to 11).

motor wheels run with suction head. At the time of highest fall of 8·5 metres (winter season) the lower turbine alone runs; on the other hand, when the fall is reduced to 4·3 metres (summer season) the two turbines run together. Five of the new sets, Nos. 6, 11, 12, 13, 14, are specially arranged for the large head, and designed as "winter turbines." On the other hand, the five other sets, Nos. 7, 8, 9, 10, 15, are specially built as "summer turbines," and arranged in the dispositions given to their turbines for running with a small head during the summer season. They develop under these conditions 850 to 1,200 h.p. at 120 revolutions per minute. The volume of the fall varies, according to the seasons, between 11,000 and 21,500 litres per second.

Owing to its great length, the shaft of the turbine is in and regulated alone by the regulator, as well as both together. It is possible, by this means, at the time of the large head, to start and regulate the lower turbine alone. Each set has an oil pump with air cushion and strainer, in which the oil returning from the regulator is cleansed of its impurities.

A third simple conical turbine, in a closed water chamber, acts with the two first ones as exciter to the sets as a whole. The exciter turbines run under the same variable head of 4·3 to 8·5 metres; they take, according to the season, 4,000 to 1,760 litres per second, developing a guaranteed horse-power of 150 h.p., and running at about 150 revolutions per minute.

Strainers.—The top supports for these consist of two girders fixed on the piers of the works facing the head-

F

race, and having sufficient space between them for taking a gate when repairs or inspection are necessary.

The strainers rest on the foundation at the bottom of the head-race. Those of the first installation consist of bars 0·120 metre wide by 0·012 metre thick, by 9 metres long, held together by cross-pieces.

As the newer Escher-Wyss turbines do not admit bodies of any considerable size, it was found necessary for these to reduce the distance of the bars to 0·039 metre from centre to centre. The strainers consist of groups 0·9375 metre in width, strengthened by small channel irons and carried by a metal framework. A footway, mounted directly on the strainers, permits of their being cleaned, and two vertical triangular screens complete this work. One is situated at the up-river end of the building in the centre of the last pier, the other closes the passage between the two types of strainers.

Admission Gates.—These are of the "sector" type, that is, they are formed of part of a cylinder turning on its axis. The radii act as framework, and the arc as the wall of the gate. The lower part, where the gate is lowered, rests exactly on the threshold of cast-iron fixed in the inverted circle of the head-race. The free movement of the grate is assured by a clearance of 0·006 metre on each side. When the gate is closed, however, its extremities rest against the sides of two angle irons bedded in the side walls, and a piece of packing, shaped like a hollow sheave, closes exactly the space between the top part of the gate and the facing wall by a special arrangement, so that the packing is as tight as could be desired.

The movement is effected by means of winches put in motion by an endless screw. This screw is controlled in one direction or the other by gearing mounted on a shaft common to all the gates. The shaft is worked by a motor, but it can also be worked by hand. The movement is transmitted to the gate by a chain passing over two pulleys, and secured to the top part of the gate. The tractive effort on the chain is 5,328 kilos., and the complete raising of the gate requires five minutes.

The Generators.

The generators, to the number of 15, were supplied as follows:—

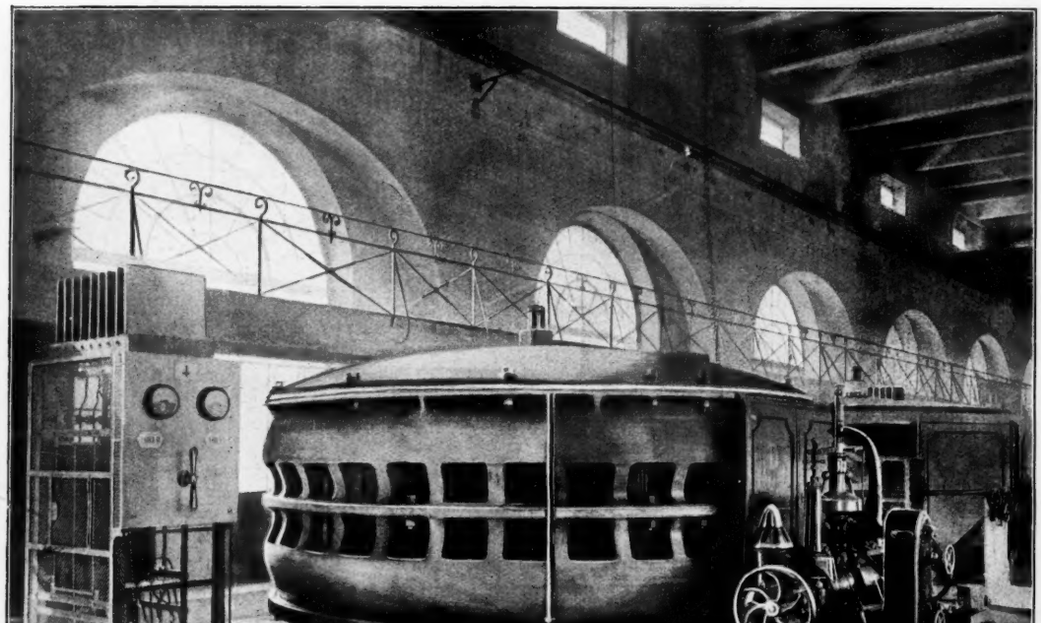
(*a*) Nos. 1 to 5 by the Compagnie de l'Industrie Electrique, Geneva, in 1895-1896.

(*b*) Nos. 6 to 11, by Messrs. Brown, Boveri & Co., of Baden, in 1898 to 1899.

(*c*) Nos. 12 to 15, by the Compagnie de l'Industrie Electrique, in 1899.

The first 14 machines are two-phase alternators; the fifteenth is for continuous current.

Machines 1 to 5.—These alternators, each of an output of 1,200 H.P., are direct coupled to the shaft of the turbines which drive them. The town engineers having called for a type of alternator of great strength, with moderate self-induction and high voltage, capable of being short-circuited without damage and of running easily in parallel, the Compagnie de l'Industrie Electrique proposed the use of a unipolar inductor alternator of the "Thury" type, with armature and magnet stationary and with vertical shaft. A similar type had previously given excellent results at Turin for the distribution of energy.



Thury Two-phase Inductor Alternators, of 1,200 H.P. each. (Nos. 1 to 5.)

The vertical shaft arrangement was chosen, owing to the restricted speed of the turbines, and the desire to avoid the use of gearing by means of direct driving; this necessarily led to the adoption of a large diameter for the moving part. Besides, the vertical shaft arrangement facilitates the dismounting and inspection of the machine; in fact, it is only necessary to unbolt the coupling and to lift the case with its shaft, for the windings of armature and field-magnets to be entirely exposed, without it being necessary to remove the pole-pieces, as in the case of horizontal shafts.

The ease with which access is gained to the windings permits of repairs being effected in a relatively short time. The solidity of the armature is increased by the fact that the windings are stationary; they are, therefore, not submitted to any centrifugal force, and have only to resist the tangential efforts

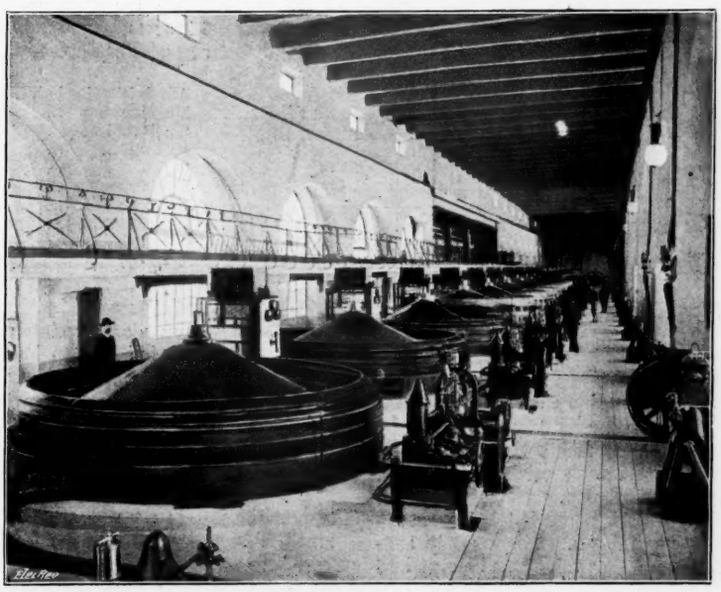
of the field; the insulation of the windings of both armature and field magnets can be effected in the best possible way, and is situated under the most favourable conditions for upkeep.

The unipolar alternators of Chèvres are characterised by the arrangement of the two surfaces which circumscribe the air-gap with a magnetic circuit, one of these being smooth, the other toothed, and the latter being movable relatively to the other. The armature winding is on the smooth surface. This arrangement is adopted for varying the intensity of the magnetic field in the air-gap without varying the total flux created by the exciting current. Hence it produces no changes either in the value or the direction of the magnetic flux. The teeth draw with them the lines of force, which are, as it were, attached to them, and always remain a fixed quantity, because the part of the armature in front of which they turn is smooth; the dimensions of the air-gap are always the same.

Hysteresis does not come into play except to a very small depth of the armature bobbins, and as there are no changes of polarity the loss of energy from this cause is very small.

The flux maintains a constant value and direction; there is no pulling, and, therefore, those vibrations are avoided which are so prejudicial in machines which have both armature and magnets toothed.

As regards the general arrangement, the Chèvres alternators have the appearance of a cylindrical cover, 4·50 metres diameter and 2·20 metres high; they are essentially built up of two parts, one part fixed and one moving; the fixed part comprises the framework supporting the case of the two armatures and the two magnet systems, the whole having the form of two tores superimposed on each other, the section being a C.



Thury Two-phase Alternators, of 1,200 h.p. each. (Nos. 12 to 14.)

The moving part is formed by a cover of cast-steel, which produces the displacement of the magnetic flux; this cover consists of a double-toothed crown, supported by a horizontal flange cast on the shaft of the machine. Each crown has 34 radially-disposed teeth, pointing inwards, and arranged in accordance with the armature bobbins; the teeth are completely visible, an arrangement which, owing to their exposure, permits a good ventilation of the armature and fields, and reduces the magnetic leakage.

The field magnet winding is formed of a ribbon of copper of rectangular section, of which the layers are insulated from each other by rubber-treated canvas; it is placed inside the C section.

The armature winding consists of 34 bobbins formed of insulated cable, and placed flat on the surface of the armature, to which they are securely bolted.

The Chèvres alternators are constructed to be able to give as required either single or two-phase currents; the two systems of field magnets and armatures, fixed one over the other, are arranged in such a manner that they can—by a relatively simple movement—be displaced with respect to each other to achieve this object.

These alternators, of a power of 1,200 h.p., have been designed for a pressure of 2,750 volts at the normal speed of 80 revolutions per minute, corresponding to 45 periods per second; by arranging the two armatures of the same machine in series, they give a single phase current at a pressure of 5,500 volts.

The efficiency of these machines, that is, the ratio of the mechanical power delivered to the shaft to the electrical power available at the terminals, is 93 per cent. at full load, corresponding to an output of 150 amperes per phase at 2,750 volts.

The continuous current necessary for the excitation of these alternators is supplied by special dynamos, described later on, whose shaft is also placed vertically. The exciting current at full load is 45 amperes for a single field.

The total weight of an alternator is 70 tons (French), the moving part and the shaft being 12 tons; the weight of the two turbines and their shaft is about 12·05 tons, the vertical pressure of the water 12 tons, so that the total load supported by the step-bearing of the dynamo is 36·05 tons. This great weight has necessitated the employment of a special bearing, which has given the best results. This bearing consists of two fitted discs, of which one, fixed to the other principal bearing, is provided with two circular grooves or chambers in connection with the forced lubrication which supplies the turbine speed regulators, the surface of the discs being sufficient to effect the support of the whole moving system in such a manner that the latter rests on a sheet of oil, and floats without any friction. A gauge-cock and a stop-valve complete the system.

The oil is recovered by the pumps, to be used over again. The lubrication of the dynamo journals is effected by the oil escaping from the step-bearing.

Machines 6 to 11.—These generators, furnished by Messrs. Brown, Boveri & Co., each absorb 1,200 h.p. They are arranged for coupling direct to the vertical shaft turbines, and can give two-phase currents at a frequency of 45 periods per second and a pressure of 5,500 volts or 2,750 volts, as required. In order to attain this, each of the phases has been formed from two independent windings, which can be arranged in series or in parallel, the excitation being constant.

These machines are of the "umbrella" type. The armature is fixed; it comprises a cast vertical case, containing inside the assembled cores which form the iron of the armature. These cores have on all their internal peripheries a series of holes, forming as many vertical tunnels, through which pass the highly-insulated windings. In order to avoid, besides, any possible chance of leakage, each of these tunnels is lined with a thick insulating tube tested previously with 30,000 volts.

The inside edge of the cores is machined in such a manner as to level the holes, and to leave only a negligible thickness of iron at this point, in order to avoid magnetic leakage.

At the lower part of the armature casing is a cast spider, whose arms support in the centre collars which guide the shaft. This shaft carries the cast magnet wheel, which is formed in the shape of a flattened cone, and has given the name of "umbrella" to this machine. On the outside periphery of this wheel are mounted the radiating pole-pieces to the number of 46, which carry the exciting bobbins, and which, in their rotary movement, pass very close to the armature in which they induce currents.

The conical form was adopted in order to raise the boss of the magnet wheel above the circumference, so as to place the top collar guiding the shaft in the same plane as the pole-pieces. By this means the magnetic efforts of thrust acting on the wheel have only a reactive effect on the journals of the collar, and do not produce any twisting effort on the shaft.

The machines, as a whole, form a compact, solid arrangement, absolutely impossible to get out of order; all the windings are in sight and easily got at without it being necessary to move any part, which makes the attention to, and examination of, the machines specially convenient; in addition, the ventilation is very good.

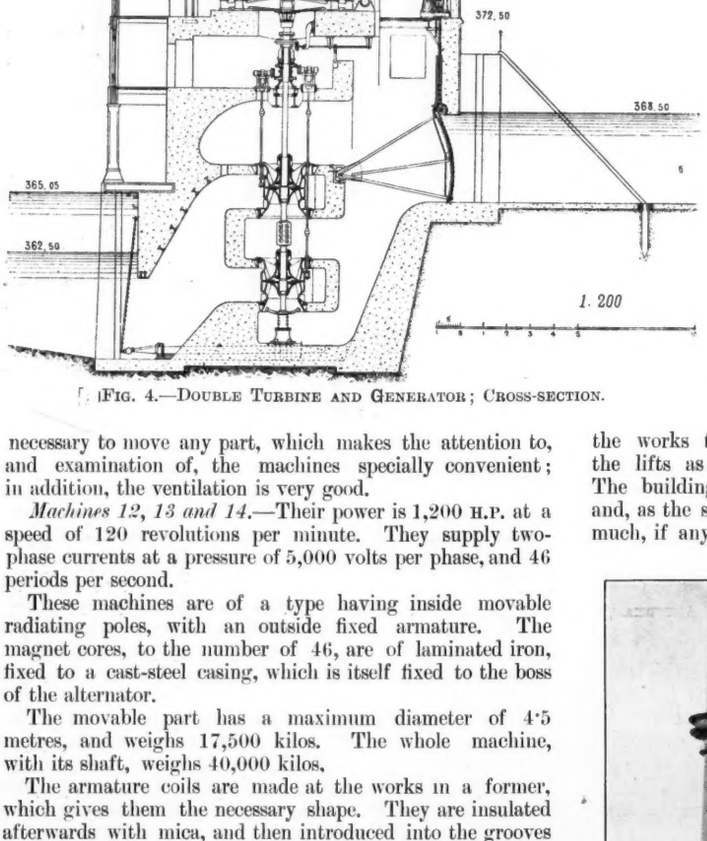


Fig. 4.—Double Turbine and Generator; Cross-section.

Machines 12, 13 and 14.—Their power is 1,200 H.P. at a speed of 120 revolutions per minute. They supply two-phase currents at a pressure of 5,000 volts per phase, and 46 periods per second.

These machines are of a type having inside movable radiating poles, with an outside fixed armature. The magnet cores, to the number of 46, are of laminated iron, fixed to a cast-steel casing, which is itself fixed to the boss of the alternator.

The movable part has a maximum diameter of 4·5 metres, and weighs 17,500 kilos. The whole machine, with its shaft, weighs 40,000 kilos.

The armature coils are made at the works in a former, which gives them the necessary shape. They are insulated afterwards with mica, and then introduced into the grooves of the armature by means of special presses.

This arrangement has the great advantage of permitting the easy and rapid replacement of damaged bobbins, whilst giving an armature reaction smaller than with completely closed tunnels.

(To be continued.)

THE WORKS OF LUDW. LOEWE & CO., BERLIN.

We are illustrating these works because they are the latest development of the best American practice in manufacturing engineering, carried out more thoroughly than has ever yet been done even in America, and with the system of interchangeability, thoroughly followed through in a manner that probably is not carried out in more than one or two places in this country. At the same time, while the articles made are largely modelled on American lines, they are not mere servile imitations, but are modified to suit the more substantial ideas held in Europe in respect of scantlings and dimensions. The whole is carried out to a point of perfection in detail that is very remarkable, we had almost said only to be found in Germany, and the detail is carried to a scientific depth that, if adhered to, and steadily persevered in, will keep these works in a leading position for a long time.

A glance at the illustrations will be sufficient to show that, with buildings of the type selected, it would be practically impossible to give more window space. Possibly better light might be obtained with the shed system of construction, though we believe that this system is not altogether fitted to German or American winters. The height of the rooms is such, however, that the admission of light is most liberal and satisfactory.

The idea at the bottom of the scheme of design is that, as far as possible, each department shall be separate and independent. There are eight principal buildings on the 14 acres of ground. Their floor space is 9½ acres. They are—

	Area in sq. ft.
Administration building.	89,300
Machine shop	112,600
Small tool shop...	63,200
Pattern „	19,600
Smith „	21,800
Foundry „	66,000
Pattern store	20,980
Power station	16,600
	412,080

Between the buildings are paved streets with grass plots, absolutely tidy. Along the streets, from building to building, and through every room in all the buildings, is laid a C. W. Hunt tramway, so arranged that one man can convey a load of 1 ton from any part of the works to any other part, being assisted only by the lifts as regards communication from floor to floor. The buildings consist only of three floors and a light cellar, and, as the streets are wide, the buildings do not shut out much, if any, light from each other. The object of the works is to manufacture machine tools of a limited variety and of moderate size, and also small tools, such as chucks, milling cutters, reamers, taps and dies, chucking tools and gauges, &c. To this end the equipment of special tools, jigs, and gauges is profuse and orderly.

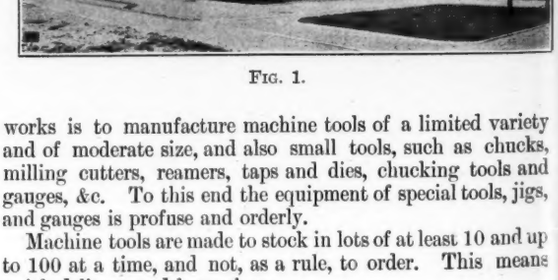


Fig. 1.

Machine tools are made to stock in lots of at least 10 and up to 100 at a time, and not, as a rule, to order. This means quick delivery and low prices.

A rigid system of inspection has been adopted. Every working part is made to limit gauges, so that parts come together with a minimum amount of fitting. The limits of the two gauges for a bored wheel, or for a spindle to fit in it, are such that the biggest spindle will not be too large for the smallest bore, nor will the smallest spindle be too slack if it happens to

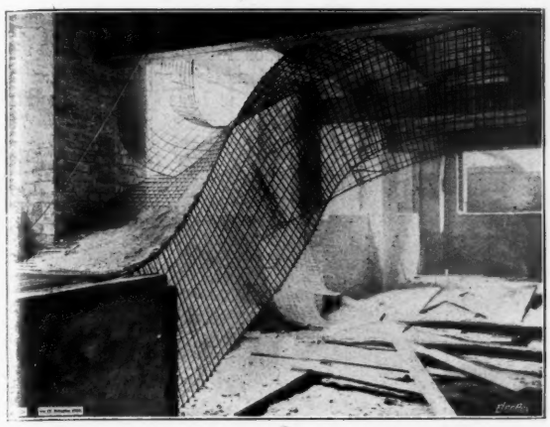


Fig. 2.

be mated with the largest bore. Manufacture on this system is very easy. All the work is really done first in fixing the limits and making the gauges; the workman then makes to these gauges, and the inspector rejects the parts that do not fill the contract. Nothing can be simpler. The marvel is that the system is not more generally followed.

To work to this degree of excellence, all important cylindrical parts are finished by grinding, the only method known of producing practically perfect cylinders. All sliding surfaces are finished by hand scraping. It is a curious fact that flat surfaces must yet be hand finished for the attainment of the highest perfection.

For the complete carrying out of an orderly system of manufacture, it is essential that men should themselves be clean, orderly, and should work in comfortable surroundings. To this end in the basement of each building is a full supply of lavatory and wardrobe accommodation, each man having his own running stream of hot or cold water for washing and a wardrobe for his clothes, so that he can change his street attire on entering the works and again on leaving it. To this end he is paid for a 10 hours' day, and works $9\frac{3}{4}$ hours, the 15 minutes being the firm's contribution to the cleanliness and order department.

In the basements of the buildings are also the large fans which supply fresh air all through the buildings. One of our illustrations (fig. 3) shows the fan with the steam valves that supply the steam to the heating coils inside the fan casings. The casings or air ducts are peculiar. They are of wire netting on the Monier system of very open work, and are laced together in rectangular form and plastered, being thus at once cheap and efficient (fig. 2). In the rooms themselves the air is delivered from sheet piping with openings at intervals, the main pipe decreasing by steps as it reaches its furthest point of delivery where it has arrived at the smallest size, namely, that of the various outlets, about 5 inches. Fresh air is thus continually forced into every room at a warm temperature when needed. No special provision needs to be made for its egress beyond openings in the wall near the floor.

The floors are of $\frac{7}{8}$ inch hard non-splintering maple, close nailed across 2-inch pine planks, which are nailed to joists sunk in the concrete floors. With light, warmth, comfort, and the ability to be clean, everything has been done to place the workman in a position, physically, to do his part, and we have as little sympathy with the idea that a workshop must be dirty, and needs no comfort, as we have with the equally false idea that the man should not do his best, or should restrict himself to attending to one machine, when he can easily attend three or five. Without doubt the men who to-day realise that it pays them to work five machines, will, before long, leave the one-machine man without even that to sleep with.

All the buildings are in connection by tunnels from cellar to cellar, and by bridges at the first floor. All floors of the same number are on one level, and the total length of intercommunicating tramway is about two miles. All men register their time in their own departments, not at the main entrance. They do this at one of 15 Rochester recorders.

The main machine hall is a long building of one floor, with arched glass roof. It is 368 feet × 102 feet, with an electric crane having movements of 100 metres per minute travelling, 10 m. hoisting, and 30 m. traversing.

Fig. 3 shows the large air pipes on each side behind the pillars. The lighter tools are in the side aisles, and their countershafts are carried by a system of overhead joist that is alike all through the works. No countershaft is fixed by drilling the joists, but the frame is clipped to the web of the joists, and can be loosened and moved instantly to a fresh position. No unnecessary time need be lost if a tool appears to be wrongly placed. The trouble of moving a tool and its overhead gearing is usually such that an inconvenient position is put up with at a constant and steady loss. With the system here in vogue moving is easy. Wherever required, overhead travellers are fitted to run on girders carried, where necessary, by hanger brackets. Looking at these works, and all that has been attempted, it is difficult to see why they should not endure many years fully able to compete with any later shops that may be built. There is as much light as can be had with the sufficient height of the rooms. Electric driving is laid on, and could be readily extended to any improved system should it appear desirable, say, to use a motor to each tool, which, so far, has not seemed desirable, the group system having been followed to some extent, and each room, at least, having its own driving.

The principle of manufacturing adopted at these works

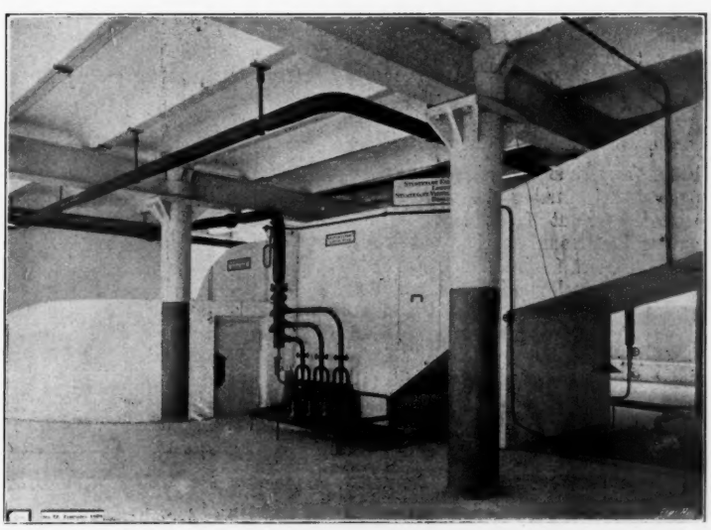


Fig. 3.

is that known as the interchangeable system. This is common enough, and is carried out in many works already, but there are various ways of employing it. It may be carried out at great expense, with excellent results as regards quality, by careful and accurate working to drawings. Again, it may be done by making to gauges as it usually

is carried out; but to carry it out in the best method at the least cost in manufacture, the limit gauge system must be adopted. Very few know what this really is, and how it is carried out. Yet it is in a sense very simple, though it requires the best of technical knowledge to scheme it out. A limit gauge is one that has two ends of a different size, if the gauge is, say, for testing a bored hole. If for testing a turned spindle, it consists of two jaws of metal cut to two different sizes, or of two discs bored to slightly different diameters.

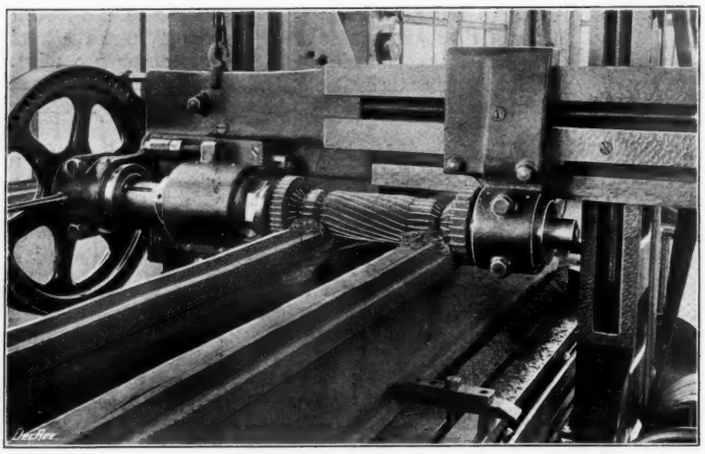


Fig. 4.

When a hole is to be made by the aid of the first or plug gauge, it must be such that one end of the gauge will not enter the hole, while the other end will do so. As an illustration, we may say one end is made $\frac{999}{1000}$th of an inch diameter, the other end is made $\frac{1001}{1000}$ths. If the small one will enter a given bored hole, and the large one will not enter it, we may at once conclude that the hole has been bored almost exactly 1 inch diameter, and is not so much as $\frac{1}{1000}$th of an inch wrong either way. The limit is ·002. To carry out work by the limit gauge system, it is first necessary to decide upon the limits of accuracy, or rather of inaccuracy, that are proper to adopt. This settled, one must have a complete outfit of hardened steel gauges to be kept in the tool room, and used as little as possible. These serve as permanent gauges and ultimate references. These are carefully copied, and the copies are used in the shops. They are of commoner make and cheaper material, and as they wear, from use, they are tested from time to time, so as to guard against their further use after they have worn too far out of truth. A set of limit gauges for manufacturing consists of a treble set, one for internal limits or holes, one for external running fits, and one for external keying fits. Of the first an example may be taken of the kind of limit for machine tool work. Holes of from $\frac{7}{16}$ inch to 4 inches will have a gauge to try them, of which the small end will be 0·0004 of an inch below nominal size. The large end will be 0·0012 too large, the utmost variation of diameter possible in the bored hole being thus 0·0016 inch. The spindles on which these bored pieces will run will have to fit external limit gauges, which, for the 3-inch spindle, will be 0·0008 too small and 0·0014 too small, the total limits being thus 0·0006 between any two finished spindles.

Thus a 3-inch hole may be actually 3·0012 at most, and a 3-inch spindle may be 2·9986 at the smallest. The difference is 0·0026, or barely $2\frac{1}{2}$ thousandths of an inch. It is unlikely in the extreme that two pieces, each at the outside limit, could come together, but, if they did, they would still be nice running fits. Suppose the other extreme. The hole is only 3·0004 inch, and the spindle is 2·9992, the difference being ·0012, or barely $1\frac{1}{4}$ thousandth. The fit would still be right. The same shaft for a keying fit would have a gauge from ·0010 to ·0004 too large; that is a limit of ·0006. These would produce results that would always give a fit, sometimes with a little pressure necessary to force the piece on its spindle. The stock gauges themselves are, of course, hardened, ground, and lapped, and guaranteed accurate to ·0001 of an inch. By this system it is commercially practicable to produce interchangeable work in every kind of machinery, and the actual shop work is done by men by no means specially skilled as tradesmen. But one might write for a year on the gauge question and not get through with it. We may, therefore, now go into the shops and note a few of these in the order in which we passed through them. The frame carrying the countershaft consists of a pair of channel bars with a clip bar above and below, the lower bar extending under the web of the ceiling joists, but all bolts being outside the joist, no joist drilling is needed.

All the air ducts are made according to the Monier system of ventilation. Fig. 3 shows some of the casing complete with the quadrant of the fan itself, and the general appearance of the cellar work. A parallel system of construction is followed in the various stairways, which are of lattice pattern in the treads, cement filled.

Milling, as the more recent development in machine work, may first be noted. Milling has largely displaced planing, and is placed under the same control. But milling is not always capable of finishing work so accurately as a planer. In fig. 4, for example, a large compound miller is at work on a lathe bed. This work is done at the rate of, at times, $8\frac{1}{2}$ inches per minute. On these planer beds, which are 15 feet long, rough milling only is done. The pieces are then laid aside to "soak" for some days, during which they change form, and twist somewhat. They are then finished by a light cut on a planer, and sent to the scraping department for final touch up. We illustrate the heavy milling room only in fig. 5, because there is also visible in this view one of the 2,000-kilogramme room travellers, and the mode of carrying its rail beam by hangers from above. No special rules can be set for milling speeds. These may vary from 1 to $8\frac{1}{2}$ inches per minute, with good reasons for each speed.

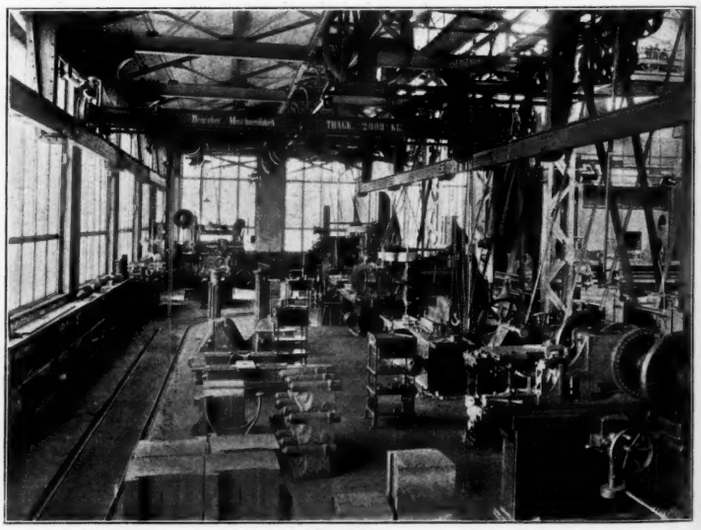


Fig. 5.

With well pickled castings of soft iron, and straight work that does not require too much roughing off, a Brown and Sharp vertical miller will feed at nearly 4 inches, where 3 inches would be its limit if there were no coring, but for

continuous work or solid, long continued, about 2 inches to 2½ inches is an economical speed. Much, of course, depends on the foundry. Too often the foundry leaves too much stock to be removed, and it is cheaper to run one cut at 1⅜ inches per minute than two cuts at 2 inches to 2½ inches speed. But a finish cut at 8½ inches can be taken without heating the cutter. Much, of course, depends on the jigs and fixtures and on the strength of the piece itself to stand the stress of a heavy cut and still remain true, also on the facilities for grinding the cutters, especially for finishing cuts at 8 inches to 9 inches speed. Thus a No. 5 B. and S. vertical miller is arranged for speeds of from $\frac{1}{16}$ inch to 29¾ inches per minute, with cutters at 10 to 267 revolutions per minute, with feeds per revolution from 0·001 inch to 0·667 inch. A feed of 3½ inches may be got with four speeds of cutter, and feeds per revolution of 0·105, 0·144, 0·493, and 0·257, and with different diameters of cutters great variation can be made in the duty. We noted that a good deal of circular milling was being done. In tool making, the milling machine cuts the flutes of reamers and taps, cuts out the teeth of wheels, and performs many operations. The Warren gear cutter for spur and bevel wheels is, of course, merely a special form of milling machine. Hand wheels are milled round their outer rims, and an enormous amount of work is now milled that was once planed or turned.

We need not say much of the turning department, which occupies all the length of the connecting wings of the first floor in the machine shop adjoining the chucking department. Most of the lathes are of the firm's own make. Parts are more cheaply cut out of the solid bar than forged to shape, and heavy cuts are made. As in other departments, special lathes are used for special work.

Fig. 6.

Grinding is now fully recognised as necessary to secure true cylinders, and all special bearings are ground to a finish. Brass bushes for spindle bearings are ground internally, being soldered together for the purpose, after they are split. They are then finished by hand scraping, that necessary operation to finish even the finest machine work. Some machines have magnetic holding-down tables. One man attends to several automatic machines, many of which stop automatically when they have ground to the necessary depth. The dry grinding machines are cleared of dust by pipes and fans. There is no dust in the shop atmosphere.

The accuracy of grinding depends partially on the fact that the piece ground is not pressed against by the tool, as by a turning tool. Even the most rigid lathe has some spring, and a cutting tool will either refuse to take a fine cut, or, if so pressed to its work as to take the cut, it will draw into the work. Hence the last fine cut of a lathe is so commonly done with a scraper tool, or even with a file, and once a file has touched the work, no hope of real accuracy can remain. The grinder, on the contrary, continues to abrade every particle that stands above the general level, but it ceases to remove material beyond that point. It cannot dig in. The accuracy of grinding is such, that the final scraping of a bearing to its spindle is very much reduced. Every hour spent on grinding will save three or four hours in the fitting or erecting shop.

No department is considered more important than the chucking department (fig. 6), in which all cylindrical holes, except in very heavy pieces, are finished. The chucking department is on the first floor of the building, adjoining the large machine hall. The term is American; we should understand it better as the boring department. In "chucking," a wheel or other part is fixed on a face plate in a jaw chuck. The casting may be solid or cored, and the first hole, in case it is solid, is put through by an ordinary twist drill. An unpointed three-lipped chucking drill of the twist variety is then run through. These drills are made ·01 inch under nominal size in the sizes up to $\frac{1}{8}$ inch, and above those sizes they are ·015 inch under size up to 1½ inches and ·02 inch up to 2 inches. The drills work rapidly, do not run out of truth readily, and can be run through a steady bush when necessary with a rough casting. The hole thus made is finished by a reamer. For most ordinary work a solid reamer will serve, but for the best limit gauge work a reamer must be fitted with loose blades to be set up to larger diameter and ground repeatedly. In the end, too, these are cheaper than solid reamers, that cannot really ream many holes without themselves becoming a very little smaller.

(To be continued.)

ELECTRICAL ENGINEERS R.E. VOLUNTEER CORPS.

Our snapshots this week represent the E.E.'s both at work and at play. One of the views shows Captain Leaf's grammaphone in operation at Rosmead Junction. This instrument, singularly enough, afforded an immense amount of amusement, not only to the electricians, but also to their comrades in arms and to the Kaffirs who were favoured with performances; the natives were greatly edified, and puzzled as to the whereabouts of the disembodied singer.

Another view shows the first sight of Table Mountain on the arrival of the volunteers in Table Bay; the remarkably flat and level top of the historic landmark is most striking. Number 2 is a view of the after portion of the train conveying the corps to Bethulie, taken during a stoppage at de Doorns on April 17th.

After spending about a fortnight at Bethulie, the stores were divided, preparatory to the division of the corps into two bodies; view No. 6 shows one portion of the stores laid out ready for departure, their nature being clearly shown by the illustration.

A stoppage took place between the Vet and Zand Rivers for the purpose of repairing a broken culvert; this operation is seen in progress in No. 1.

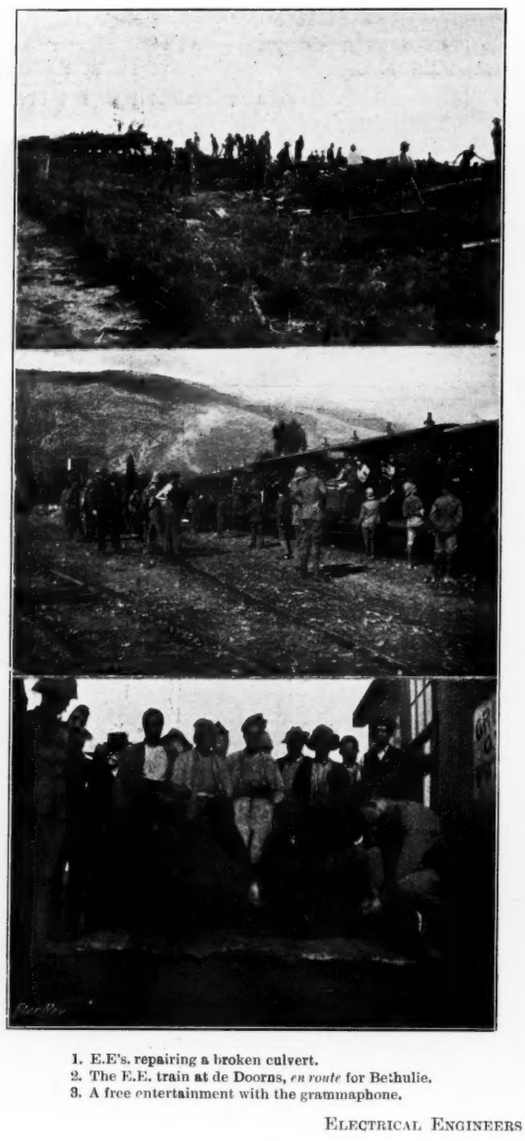
That electrical engineers are able to turn their hands to anything (providing, of course, that it is honest) is no news to our readers; it is, however, something of a novelty to find them milking a cow! That they did so is evidenced by view No. 4, taken at Pretoria after their return from the railhead.

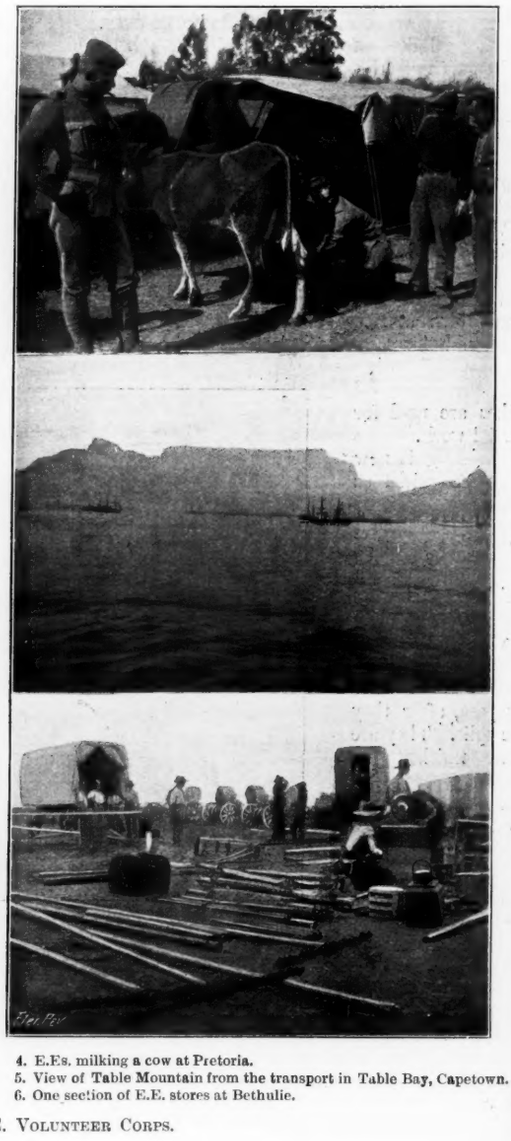
We have pleasure in giving below some particulars of the whereabouts of the members of the corps and some of the work which they have accomplished.

The following is an exact list of Officers, N.C.Os., and men of the E.E.R.E. and their stations on September 28th, 1900:—

still be nice running fits. Suppose the other extreme. The

	Major R. E. Crompton ...	Left Pretoria headquarters on 26th inst. by 12.30 p.m. train to Capetown *en route* to England. Believed to be sailing by ss. *Saxon*.
	Capt. F. L. Lloyd, now O.C. E.E.R.E. and O.C. Steam Transport.	Headquarters, Pretoria.
	Capt. A. Bain	Rly. Telegraphs, Elandsfontein.
	Capt. H. M. Leaf	Machadodorp, lighting the railway depôt.
	Lieut. J. F. O'Shaughnessy	Rly. Telegraphs at the front.
	Lieut. A. H. Pott	Invalided home.
	2nd Lieut. J. H. Stubbs ...	Army Telegraphs, Standerton.
	2nd Lieut. A. H. Bigg ...	In charge of S.I. party Whitbank Colliery.
	2nd Lt. F. Powell-Williams	Headquarters, Pretoria.
6,186	2nd Corpl. J. Rook ...	Rly. Telegraphs, Elandsfontein.
6,206	,, J. H. Stone ...	Now 2nd Lieut. R.F.A., Harrismith.
6,264	,, E. M. Sellon ...	Middleburg, slight touch fever, in hospital.
6,183	Lce.-Cpl. H. R. Allen ...	Headquarters, Pretoria.
6,210	,, G. Charlton ...	Search lights, Whitbank.
6,194	,, D. F. Colson ...	In hospital, Pietermaritzburg; poisoned hand, progressing.
6,187	,, M. N. Crawford	Bloemfontein.
6,201	,, C. Landon ...	Headquarters, Pretoria.
6,175	,, C. F. Love ...	Acting-Electrician-in-charge at Government Printing Works, Pretoria.
6,209	,, A. E. Levin ...	Headquarters, Pretoria.
6,168	,, S. W. Melsom ...	Search lights, Whitbank.
6,185	,, A. R. Peart ...	Machadodorp.
6,266	,, A. O. Wiltshire	Superintending lighting contractor's work, Johannesburg.





1. E.E's. repairing a broken culvert.
2. The E.E. train at de Doorns, *en route* for Bethulie.
3. A free entertainment with the grammaphone.
4. E.Es. milking a cow at Pretoria.
5. View of Table Mountain from the transport in Table Bay, Capetown.
6. One section of E.E. stores at Bethulie.

Electrical Engineers R.E. Volunteer Corps.

16,721	Sergt.-Mjr. G. A. Brown...	Field telephones at front.
6,263	C.-Sergt.-Mjr. E. Rorke ...	Headquarters, Pretoria.
21,109	Sergt. C. T. Ruse (acting C.S.M.)	,, ,,
6,166	Sergt. J. H. S. Phillips ...	,, ,,
6,171	,, W. S. Entwistle ...	Rly. Telegraphs, Elandsfontein.
6,193	,, T. H. Brown ...	Headquarters, Pretoria.
6,192	,, A. H. Graham ...	Machadodorp, with Capt. Leaf.
6,173	Cpl. H. H. Bicker-Caarten	N.C.O. in charge of section Bloemfontein, lighting railway station and works.
6,191	,, A. Charlton	Headquarters, Pretoria.
6,179	,, W. Dalton	Field Telephones at front.
6,178	,, W. H. Hossack ...	Headquarters, Pretoria.
6,205	,, D. G. W. Hume ...	Now 2nd Lieut. R.F.A., Pretoria.
6,170	2nd Corpl. A. J. Hodgson	Headquarters, Pretoria.
6,271	Sapper F. D. Arundel ...	Bloemfontein.
6,199	,, H. Bertram ...	,,
6,169	,, J. M. Bowrey ...	Headquarters, Pretoria.
6,196	,, R. H. Brander ...	Invalided home.
6,180	,, W. C. Cooke ...	Rly. Telegraphs, Standerton.
6,267	,, H. F. Claxton ...	Headquarters, Pretoria.
6,269	,, W. G. Carter ...	Machadodorp.
6,197	,, A. J. C. Devonshire	,,
6,177	,, G. J. H. Elliott ...	Headquarters, Pretoria.
6,203	,, R. W. Holliday ...	Rly. Telegraphs, Elandsfontein.
6,188	,, E. C. Horsley ...	Machadodorp.
6,184	,, J. H. Hounsfield...	Bloemfontein.
6,268	,, A. E. Minns ...	,,
6,174	,, H. A. Paris ...	,,
6,198	,, N. W. Pirrie ...	Headquarters, Pretoria.
6,165	,, F. J. Phillips ...	,, ,,

6,273	Sapper	C. W. S. Paine	... Headquarters, Pretoria, employed under I.M.R.
6,272	„	F. G. Payne	... Bloemfontein.
6,182	„	R. B. Roberts	... Headquarters, Pretoria.
6,195	„	C. E. Silverthorne	Search lights, Whitbank.
6,190	„	F. C. Stephens	... Rly. Telegraph instrument work at front.
6,207	„	C. R. H. Thorn	... Invalided home.
6,208	„	B. H. Tilley	... Army Telegraph, Standerton.
6,270	„	J. P. Taylor	... „ „
6,200	„	F. J. Wallis	... Search lights, Whitbank.
6,189	„	E. J. West	... Rly. Telegraphs, Elandsfontein.
6,172	„	E. J. Wright	... „ „
6,181	„	F. J. Young	... Headquarters, Pretoria.

Civ. Servant W. Reed, with Major Crompton.
„ J. Warder, to Capt. Lloyd.
14,102 Private J. Surridge, of 47th Cy. Imperial Yeomanry, Officer's Servant, Pretoria.
6,865 Private H. J. Dennis, of 44th Cy. Imperial Yeomanry, E.E. Cook and Officer's Servant, Pretoria. This Private is an E.E. Volunteer Sapper and joined at Roodeval.

The E.E. Volunteers have also attached to them now 14 Infantry and 1 N.C.O. of various regiments as a permanent escort for steam transporting.

A Lance-Corpl. of the Cornwalls is acting as messenger.

30 Native-boys are with the corps as general labourers.

12 Civilian Engine Drivers, under the supervision of E.E. men, are also attached with two engines from Aldershot.

A Q.M.S. from the Royal G. Artillery, with his engine the "Ursula," has also made an excellent addition to the steam transporting staff. The "Ursula" is now taken over by E.E.R.E., Capt. Lloyd being O.C. transport. The Q.M.S. is also remaining and giving very useful assistance to the men.

WORK IN HAND.

Electric Lighting—Pretoria.

1. *No. 2 General Field Hospital.*—This hospital consists of marquees and bell tents, and has an accomodation for about 1,500 patients. The wiring is being done on an overhead bare conductor 3-wire system; about 90 poles in all will be used. There will be about 300 8-c.p. lamps. The work is now about three parts finished.
2. *Advanced Base Medical Store.*—About 20 8-c.p. lamps, just commenced.
3. *Sterilisation of Milk Depôt.*—About 20 8-c.p. lamps, not started.
4. *Wonderboom Fort.* — Re-wiring entanglement, about half finished.
5. *Staats Printing Works.*—Running of plant.

The above is about six weeks' work.

Transporting—Pretoria.

1. *Supplies to Rietfontein as required.*—About four times a week.
2. *Coal Supplies to Hospitals, Forts and Pumping Stations as required.*—One of the above stations, and sometimes two, per day.

Electric Lighting Jobs Finished in Pretoria, and their Equivalent in 8-c.p. Lamps.

1. *Two large sheds of the East Supply Depôt Stores.*—Two sets of railway lines run between them near the railway station. Each has a middle and an outer wire running along its whole length. (60.)
2. *Advanced Base Military Post Office.*—Near station. (60.)
3. *Branch Army Post Office.*—Church Street. (8.)
4. *Commissariat Stores.*—Market Street. (100.)
5. *Railway Telegraph Stores.*—Staff-Officer commanding :—Capt. Mannifold, R.E., close to E.E.R.E. Camp. (40.)
6. *Extensions* to No. 5, as above. (10.)
7. *Military Bakery* formally Z.A.R. jam factory, opposite E.E.R.E. Camp. (26.)
8. *Rest Camp.* (4.)
9. *Klapperkop Fort, Officers' Quarters.* (16.)
10. *West Fort, Mens' Quarters.* (40.)
11. *Schantzkop Fort.* (8.)
12. Put in working order the oil engine plants of the three above-named forts.
13. *Troops' Coffee Shop.*—Near station. (8.)
14. *Commander-in Chief's Office.*—Mare Street. (24.)
15. *Chief of Staff's Office.* (6.)
16. *O.C.—A.S.C's. Office.* (8.)
17. *No. 1 Military School Hospital.* (70.)
18. *No. 2 Military School Hospital, and Nurse Quarters.*—Opposite. (20.)
19. *Yeomanry Branch Hospital,* Eastwood.—This hospital is the house of Mr. Beckett, a very large tradesman. (210.)

The following officers, N.C.Os. and men are remaining in South Africa at the termination of the war:—

2nd Lieut. J. H. Stubbs.	6,272	Sapper	C. W. S. Paine.
6,193 Sergt. T. H. Brown.	6,195	„	C. E. Silverthorne.
6,209 Lc.-Corpl. A. E. Levin.	6,190	„	F. C. Stephens.
6,203 Sapper R. W. Holliday.			

The above N.C.Os. and men have, through the great influence and popularity of Major Crompton—together with the great trouble he has taken on their behalf—obtained some excellent appointments, and desire to thank him through the medium of our columns.

CONTRACTS OPEN AND CLOSED.

(*Continued from page* 664.)

London.—November 13th. The L.C.C. wants tenders for about 150 arc lamps (80 10—12 amperes and 70 5—6 amperes) for the lighting of the Victoria Embankment and Westminster Bridge. See "Official Notices" to-day.

Lowestoft.—November 2nd. The Corporation wants tenders for two water-tube boilers, economiser, pipework, and one 250-kw. steam dynamo. See "Official Notices" October 19th.

Lowestoft.—November 2nd. The Corporation wants tenders for wiring the Town Hall. See "Official Notices" October 19th.

Pemberton.—November 8th. The Council wants tenders for boilers, engines and dynamos, battery, switchboard, crane, and conductors, for electric lighting. See "Official Notices" October 19th.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Swansea.—October 29th. The Corporation invites tenders for electricity meters, demand indicators, and main fuses. See "Official Notices October 19th.

Walker.—November 12th. The U.D.C. wants tenders for the erection of a 2-unit Meldrum destructor, including boilers, steam pipes, &c. See "Official Notices" to-day.

CLOSED.

Barnsley.—The Corporation has placed an order for a 600-h.p. generating set of P.P.P. combined lighting and traction type, with Messrs. D. Bruce Peebles & Co. It will consist of a machine direct coupled to a Willans engine.

Dundee.—The Town Council has accepted the offer of the Bellfield Iron Works, Limited, to supply three steel water tanks for the electric light station at £676.

Glasgow.—The tender of Messrs. Mechan & Sons for transformer connecting bars for the sub-stations of the new electric tramways of the Corporation has been accepted, one of the conditions being that work shall be finished by January 1st, or at latest January 16th, 1901.

Hackney.—The Electricity Committee has recommended the Vestry to place the contract for cables, troughing and trenching work, distributing boxes and house services with the British Insulated Wire Company. Their various tenders for the different items make a total of about £46,000. The *Contract Journal* states that the Committee has also recommended the acceptance of the following tenders: — Cole, Marchant & Morley, Limited, for condensing plant, £4,749; Klein Engineering Company, Limited, for cooling apparatus, £1,960; Aiton & Co., for pipework and valves, £5,065; Worthington Pumping Engine Company, for feed pumps, £753; S. Z. de Ferranti, Limited, for switchboard and instruments, booster and motors, &c. (Part 1), £2,976 10s.; Johnson & Phillips ditto. (Parts 2 to 5), £2,160, public arc lamps and switchboard, £5,248 18s. 6d.; Chamberlain & Hookham, Limited, house meters, £3,632 10s.; Higginbottom & Mannock, for overhead travelling crane, £638; Easterbrook, Allcard & Co., workshop equipment, £772 2s. 4d.; W. T. Allen & Co., 132, Queen Victoria Street, E.C., arc lamp pillars, £13 5s. per pillar; Manlove, Alliott & Co., Nottingham, for the supply of a disinfector laundry machinery (driven by electric motor), £701 2s.

Suffolk.—The contract for wiring, &c., for electric lighting the Suffolk County Asylum at Melton, has been given to Messrs. Mann & Co., of Norwich.

FORTHCOMING EVENTS.

Friday, October 26th.—At 5 p.m. Physical Society Meeting:—(1) "Exhibition of Experiments Illustrating Certain Phenomena of Vision." By Dr. Shelford Bidwell, F.R.S. (2) "On the Concentration at the Electrode in a Solution, with Special Reference to the Liberation of Hydrogen by the Electrolysis of a Mixture of Copper Sulphate and Sulphuric Acid." By Dr. J. S. Sand. (3) "Electromotive Force and Osmotic Pressure." By Dr. R. A. Lehfeldt.

At 8 p.m.—Institution of Junior Engineers. Annual general meeting at the Westminster Palace Hotel.

Saturday, October 27th.—At 7.30. Newcastle-on-Tyne. Annual meeting of the N.E. Coast Institution of Engineers and Shipbuilders. Presidential address by Mr. Henry Withy. Paper on "The Stress Produced in a Connecting Rod by its Motion," by Mr. C. H. Innes, M.A.

Thursday, November 1st.—At 8 p.m. The Röntgen Society. Ordinary general meeting at 20, Hanover Square. Presidential address by Dr. J. B. MacIntyre.

Thursday, November 8th.—Institution of Electrical Engineers. Opening meeting for the new session, when Prof. John Perry will deliver his inaugural address. Presentation of premiums.

NOTES.

Essentials of a Good Stoker.—The attention that has been given in America to the prevention of smoke has carried American thought very much along the same lines as it has followed with ourselves. Writing in the *American Electrician* on the question of stoking by machinery, Mr. A. L. Harrison states that on the coking system alone can the operation be smokelessly carried out, and he gives as an essential that the feed-plate surface or dead plate should have 1 lineal foot of surface for each 4 square feet of grate surface. Probably lineal is a mistake, and square was meant. The next essential is a furnace arranged so that the volatile gas is burned off before the fuel is pushed off the dead plate and upon the grate, and the furnace should be capable of burning anywhere from 15 to 40 lbs. per square foot. A third essential is that the furnace should always be clean, and in a condition to do work without admitting too great an excess air. We can quite understand that all these desiderata may be obtained with underfired boilers, and even with water-tube boilers, if specially arranged for smokeless combustion, but they are more difficult to secure with internally fired boilers. Much of the commercial advantage of mechanical stoking is to be got by using inferior fuels. We think no stoker is of much use that cannot be supplied with coal by some mechanical means, and it remains as true now as ever that even with full coking there cannot be smokeless combustion in any furnace which sends up its products of combustion directly from the grate among a lot of cold water pipes, as in ordinary forms of water-tube boiler, which will smoke even with so-called smokeless Welsh.

The Sorrows of the N.T.C.—The case of the National Telephone Company *v.* Pass & Company, 64 J.P. 651, which was heard by Mr. Commissioner Kerr in the City of London Court early this month, affords a striking instance of the difficulties with which the National Telephone Company have to contend. It appears that they had contracted to erect a private telephone wire for the defendants. The wire was erected and had been in operation for five years, but when the time came for payment of the sum of £50 (being five years' rent of the wire), the defendants refused to pay, alleging (1) that the wire had never been efficiently fixed; (2) when they used it they heard voices in the Exchange, although it was supposed to be a private telephone. The company had not guaranteed that the telephones would always work. They only did their best in the matter, and could do no more. Such was the plaintiffs' story told by their representative to the Commissioner, who, nevertheless, turned a deaf ear, and gave judgment for the defendants. It appears that the inhabitants of that district of London through which the private telephone was erected relieved the monotony of their existence by hurling dead cats, old tin pots, and every other abomination at this particular portion of the property of the National Telephone Company. Small wonder that the service was occasionally interrupted.

"My Moving Tent."—A house was recently moved in Wellsville, Ohio, by electric power taken from a trolley line. The house was being moved along the street where there was an electric car line. Two cars were hitched to the house by a rope, and it was quickly pulled to its new destination.

Electric Tower at the Pan-American Exposition.—The Pan-American Exposition Company has made material modification in the plans and design for the electrical tower. The style of tower which it is now proposed to erect will be built after a plaster model made by John Galen Howard, of New York. Mr. Howard's plan calls for a tower 375 feet high. The frame will be of steel, and upon it will be placed the wood and staff required to complete it in order that it may be an object of beauty. The base will be 70 feet square; on the four sides there will be great panels of rich open work design, and it is expected that at night, when the interior is lighted, these will show brilliant effects. The crown of the tower will be in three parts; the first an open loggia with pavilions and cupolas at each corner, surmounted by a high circular colonnade inclosing a spiral stairway which will lead to the lantern or look-out, the highest point to which a visitor may go. From this look-out a panoramic view of the Exposition and city will be obtainable. High upon the summit of the tower will stand a beautiful figure of Electricity. On the southern face of the tower, at the base, will be a cascade 60 feet high and 30 feet wide, which will be brilliantly illuminated in colours by electric lights. From the east and west sides of the base of the tower two curved colonnades sweep to the southward about 60 feet, the extreme ends of which will be surmounted by pavilions that are richly embellished with statuary and other plastic ornamentation. This tower is to stand in a broad basin, and all about the base will be a multitude of hydraulic and fountain effects. It will be the electrical centre-piece of the Exposition. Much study and expense are being devoted to developing the electrical display, which is expected to out-distance anything the world has ever seen. The tower will stand at the north end of the court of fountains, and about the tower for outdoor illumination over 200,000 electric lights will be used. It is expected that no less than 250 tons of insulated wire will be used in the preparation.

A Little Girl's Hoop.—The following incident is related in the columns of the New York *Electrical World*:—"Part of the Washington street car system was tied up on October 4th by a little girl's hoop. Late in the afternoon she was rolling the hoop along C Street Northeast, when it rolled on the tracks of the electric railroad. Just as a car came along the hoop fell into the slot between the tracks. The hoop got white hot. The car stopped with a jerk, and in a few moments a crowd was gathered around the strange obstruction. No one dared touch it or even approach very near. Before long the cars which came along behind the first car were halted, and there was a blockade all along the line. All sorts of schemes were tried, and all failed. It was half an hour before the employés of the road gave it up and telephoned to the power house to turn off the power, and it was long after that before traffic on the street was in a normal condition. The child during the whole disturbance had been crying and lamenting the loss of her hoop. As a result of this incident, the trundling of hoops in Washington has been forbidden by a police ordinance."

Lectures.—At Dumbarton Parish Church on 18th inst. Mr. Archibald Denny delivered a popular lecture on "Electricity," in the course of which he referred to the use of electrically driven tools in his own shipyards, thereby lightening the labour, cheapening and increasing the output, and employing more men. He reproved the Commissioners of Dumbarton for neglecting to face the electric lighting question when gasworks extensions recently came under consideration.

The Master Electrical Contractors' Association of Dublin will meet on Monday evening, November 5th, to listen to a lecture by Prof. Forbes, F.R.S., on "Electrical Utilisation of Water-power and the Niagara Scheme." The meeting will be held at the new D.B.C., Sackville Street, Dublin, under the presidency of the Lord Mayor, Sir T. Pile. The invitations are headed, "To meet Prof. Forbes, F.R.S."

One of a series of lectures to be delivered at Glasgow on Corporation work is to be by Mr. W. A. Chamen, on the subject of "The Municipal Electric System."

The Belleville Boiler.—On the 12th inst. numbers of blue jackets appeared to be *en route* for Chatham to join the *Hyacinth*. There seems to be reason to suppose that the trials of this ship by the Committee on Boilers are about to be commenced. Already the *Europa* has had a full-powered run, when she developed the magnificent speed of 10 knots, and it is "rumoured"—we quote a morning paper that appears half posted only in matters naval—that the cause of the mischief has been found. This is truly rich. Here is a huge cruiser with machinery well and truly calculated to be capable of over 20 knots. She creeps at 10 knots, and a Committee has to be appointed to find out why. We wonder what would happen to the engineer of a Lancashire cotton factory if his 1,000-H.P. engines refused to develop more than 500 H.P. and if he was unable to point out the reason why in a few minutes. Yet the *Europa* has been to Australia, and has come back again, and either it is a fact or it is a polite fiction that her engineers do not know why she steams so slowly. Of course they know. It would not be proper to blurt out the plain truth. Better sink the Navy and welcome the heavy foot of invading Europe than call on Mr. Goschen or his advisers to explain why £180,000 was paid in order that 62 ships of the British Navy should be incapable of defending our shores for lack of speed. With the Duke of Marlborough justifying the War Office, it is perhaps supererogatory to even hope for a good Navy from the powers that be, who have brought it to its present pass, but possibly the retirement of Mr. Goschen signifies a change of policy, and that in the future our Navy is not to be kept distinctly helpless?

That our innumerable strictures passed on the Belleville boiler were substantially correct is being amply proved. The latest announcement is to the effect that the first-class cruiser *Europa* was paid off at Portsmouth this week in order that her boilers might be repaired. "The *Europa* is fitted with Bellevilles, which have given unsatisfactory results during the ship's recent voyage to Australia and back."

Toys for a Bad Boy.—The U.S. Consul at Constantinople tells a funny tale about the Sultan. It has been alleged repeatedly that Abdul Ahmid is inclined to confuse dynamos with dynamite, to the detriment of the former, and there is actually in existence a general interdiction against dynamos, electrical plant, telephones, &c. But, in the face of this, a few months ago some enterprising American trader managed to get off a shipment of electrical appliances to Constantinople. These were duly seized and lodged in the Custom House. To admit them to the great Ottoman Empire was out of all reason until the U.S. Consul interposed, and insisted upon samples of some of the small electric reading lamps, and electric toys with tiny batteries, being placed before the Sultan personally. This was an admirable move, and was perfectly successful, for the Sultan bought the whole consignment for his personal use, presumably to lighten the dark places in his harem, and to amuse the occupants thereof. But there is more than this; he is stated to have issued an Iradé authorising the introduction of similar articles into the country. It should require only another step to obtain the removal of the restrictions against all electrical machinery. Why does not the British Consul walk up to the palace gate with a 2,000 KW. generator upon his shoulder? The Sultan would be unable to resist its fascinations, and might even buy it up. Who knows? The English Consul would then have beaten his American rival.

Suspension Railway.—In the presence of a large and distinguished company, the Barmen-Elberfeld-Vohwinkel suspension railway was opened at Elberfeld on Wednesday. The railway is the invention of the late Herr Eugen Sanger, of Cologne, and consists of a single overhead rail, supported at a height of 8 m. by iron trestles, the carriages swinging below the rail as in a ropeway. The line is 13½ km. in length, following the course of the River Wupper; it is double throughout. At present only the Elberfeld portion is complete. The motive agency is, of course, electrical, power being supplied from a generating station at Elberfeld.

Fatality.—An inquest was held at Sheffield on 17th inst. into the death of Ernest Liversedge, an electric pumping engine attendant at the Tinsley Park Colliery. It seems that some machinery, the belt of which was being held at the time by Liversedge, started running without any warning of any kind. We need not mention all the details, but the belting and machinery played havoc with the man, causing his death. The sad affair is attributed to a defective switch, or, rather, to a defective switching principle. The evidence of the colliery electrician, Mr. J. C. Dodd, who was in charge of the machine at the time, is recorded in the local papers as follows:—

> He stopped the machine to allow Moore and deceased to go down into the motor room. Owing to a defect in one of the switches, which set up short circuiting, the machine started. There was nobody near enough to the machine to start it. During his seven years' experience he had never before known a motor machine to start owing to short circuiting. The defect referred to was, in witness's opinion, brought about by generation of steam inside the switch-box.
>
> Mr. Neal: Do you say that this particular switch, or the principle of this type of switch, was defective?—Witness: The principle of the switch altogether.
>
> Thomas Richard Thornton, mechanical engineer at the colliery, said he was close to the machine when it started working, and it was impossible for anybody to have interfered with it.
>
> The jury returned a verdict of "Accidental death," the Coroner remarking that in all probability further investigations would be carried out by other authorities.

Personal.—Mr. T. W. W. Melhuish, who has been 14 years in Vienna as manager and chief engineer of the central electric lighting station there of the Imperial Continental Gas Association, has recently been appointed consulting and inspecting electrical engineer to the Association and some other companies in which the Association is interested, and will remove now to 23, Boulevard Militaire, Brussels, as this town is more conveniently and centrally situated as regards his new duties.

At Stirling last week the contractors for the electric lighting plant and the staff of the electricity works presented Bailie Wylie, convener of the Electricity Committee, with a handsome clock, as a token of their respect and esteem.

Appointments Vacant.—The Warrington Corporation want an electrical engineer at £250 per annum. The Bury Electric Lighting Committee want an assistant engineer at £110 per annum. An assistant engineer at £120 per annum, and a junior assistant at £78 per annum, are required for the Darlington electricity works. See "Official Notices" to-day.

Society of Arts.—A course of four Cantor Lectures on "Electric Oscillations and Electric Waves," will be delivered by Prof. J. A. Fleming on Monday evenings, commencing November 26th.

Municipal Trading.—On Wednesday evening, at the dinner of the Political and Economic Circle of the National Liberal Club, Mr. Emile Garcke read a paper on "The Limitations of Municipal Enterprise."

Electrical Engineers R.E. Volunteers.—We are informed by the officer commanding, Major R. S. Erskine, that recruiting for this corps begins on November 1st, at the Headquarters, 13, Victoria Street, S.W., at 7 p.m., and will be continued on every succeeding Tuesday and Thursday at the same time and place until further orders.

Röntgen Rays.—The *Standard* Berlin correspondent says that as a result of experiments made by Signor Briguiti, of the State Archives, in Rome, it has been found that the so-called Röntgen rays can be utilised, in certain cases, for the examination and copying of manuscripts concealed under the covers of books, &c., the rays penetrating wood, leather, and cardboard. This can only be done, however, when the ink contains some mixture of red lead, cinnabar, or ultramarine. In that case the rays will also serve for the detection of forgeries in manuscripts.

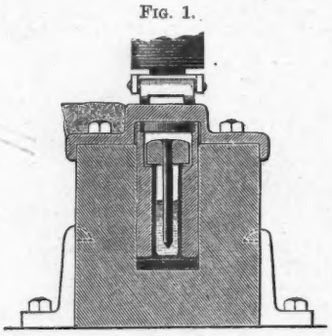
rope, and it was quickly pulled to its new destination.

subject of "The Municipal Electric System."

A Technical Dictionary in Three Languages.—The Council of the Institution of Mechanical Engineers has considered a communication received from the Society of German Engineers in Berlin, stating the need that was felt there for a reliable technical dictionary in German, English, and French. The Berlin Society asked that the English and French Societies should give their assistance in the production of such a work, and requested the Institution of Mechanical Engineers to appoint members to assist. At last week's meeting of the Institution Mr. E. Worthington, the secretary, said that the Council had decided that the Institution, as a body, could not take any action in the matter, but had informed the German Society that the proposal would be placed before the members with a view to individual assistance being rendered. Sir W. H. White, the president, said there was no want of sympathy with the movement on the part of the Council. The only question was as to the best way of giving effect to the suggestion. After a brief discussion, it was agreed that the names of any members who were willing to give any assistance would be communicated to the German Society. A paper by Mr. Bryan Donkin, entitled "Observations on an Improved Glass Revealer for Studying Condensation in Steam Engine Cylinders, and Rendering the Effects Visible," was afterwards read.

Closed-Conduit Traction.—The New York *Electrical Review*, in a recent issue, gave some illustrations of a new system of electric traction, making use of a sectional conductor connected appropriately to a feeder as the car passes over it. Fig. 1 shows the working conductor and one of the contact-making devices in section. Installed between the two rails of the track is a sectional rail, which may be of any convenient shape, but preferably one similar to that shown in the illustration, since this presents a small surface in the street, and can easily be worked in with the pavement. This rail is divided into sections longitudinally, the length of

Fig. 1.



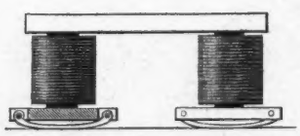


Fig. 2.

each section being about one-quarter that of the cars which are intended to run over it—on ordinary track, say, about 12 feet. This rail is laid on a continuous stringer of wood or concrete, in which, at intervals of about 4 feet, are placed the contact-making receptacles well illustrated in fig. 1. These consist of a porcelain shell containing an aluminium cup. The cup is partly filled with mercury, and in this is immersed the stem of the rivet-shaped contact-making device, which is adapted to be attracted upward against the under surface of the working conductor when the latter is magnetised. Attached to the car is a pair of electro-magnets, shown in fig. 2, hinged to which (solely for convenience) are the current-taking devices shown in the same figure. These magnets are energised by a storage battery of small size, carried on the car, and adapted to be recharged by connection to the lamp circuit of the car. Its energy consumption is, of course, very small, and may be made as little as 50 to 100 watts. As this device sweeps along over the iron or steel sectional rail, it produces in the latter magnetic poles, which attract the rivet-shaped contact-making pieces described above. Interposed between the head of each of these and the lower surface of the rail is a copper or brass washer, so that any slight residual magnetism in the rail itself will not cause the contact maker to stick to it and fail to fall back. The operation of the system is easily to be understood from the above. As the car runs along the contact makers come up under it, energising in succession the various sections of the sectional conductor, and thus supplying current to operate the car. As the contact maker cannot fall while current is on it, or unless it is shunted with another similar device, it is practically impossible to have sparks in the switch devices. It is intended that a strap conductor shall be run along in the groove under the various switches, as shown in the illustration, and from this the current fed directly, though this construction is not essential. The system, which is the invention of Mr. Lowell M. Maxham, is operated by the Bay State Traction Company, of New York and Boston.

Bankruptcy Proceedings.—On October 16th at the Wandsworth Court, Mr. Cornelius Bennett Harness, of 20, Macauley Road, Clapham, Surrey, and late managing director of the Medical Electrical Institute, Limited, of 52, Oxford Street, Middlesex, was adjudicated bankrupt. The first meeting of creditors is to be held at 24, Railway Approach, S.E., on October 31st at 11·30 a.m. The public examination takes place at the Court House, Wandsworth, on November 8th, at 12 noon.

Motor Cars at Manœuvres.—Major T. B. Mott, U.S.A., who represented the United States at the recent French manœuvres, is reported, says New York *Electricity*, as making the following statement on the utility of automobiles in the army:—"The manœuvres proved extremely interesting and instructive. From several points of view, the extensive use of auto-cars was a most striking innovation, and the results attained have fully justified the claim for their practical utility in European warfare. They did excellent work, enabling the generals and their messengers to cover great distances in a few hours. Auto traction cars, moreover, immensely facilitated the work of the commissariat department, each drawing six or seven cars heavily laden with provisions. They have undoubtedly come to stay. I examined this question of military automobiles, however, from the American standpoint, and while fully appreciating the enormous service they render to the armies of Europe, where the highways are level and well built, and the distances comparatively small, I do not believe they would be of sufficient value on the rough American roads and over enormous tracts of country, as in the United States, to justify the heavy expense of their introduction and maintenance in the American Army."

NEW COMPANIES REGISTERED.

Colwyn Bay Electric Light and Power Company, Limited (67,480).—This company was registered on October 17th, with a capital of £3,000 in £1 shares (1,000 preference), to adopt an agreement with T. S. Jones and R. H. Jones, to acquire the business carried on by them at Vron Haulog, Colwyn Bay, and to carry on the business of electric light and power producers, manufacturers of and fitters of electrical appliances, &c. The first subscribers (each with one share) are:—T. S. Jones, Ivy House, Castle Bromwich, commission agent; R. H. Jones, Vron Haulog, Colwyn Bay, electrical engineer; Hannah Jones, Vron Haulog, Colwyn Bay; Clara S. Jones, Ivy House, Castle Bromwich; A. Horobin, Bascombe, Mostyn Road, Colwyn Bay, ironmonger; T. Homan, St. Paul's Arcade, Colwyn Bay, tobacconist; and Harry H. Rose, Woodside, Rhiw Road, Colwyn Bay, confectioner. The number of directors is not to be less than three nor more than five. Rowland H. Hughes is the managing director; qualification, £50; remuneration as fixed by the company. Registered office, Vron Haulog, Colwyn Bay.

complete. The motive agency is, of course, electrical, power being supplied from a generating station at Elberfeld.

or ultramarine. In that case the rays will also serve for the detection of forgeries in manuscripts.

King Arc Lamp Company, Limited (67,490).—This company was registered on October 18th, with a capital of £5,000 in £1 shares, to carry on the business of manufacturers of, dealers in, and agents for electric lamps, fittings, plant, outfit, tools, appliances and apparatus, and in particular to acquire certain patent rights in respect of the King arc lamp. The first subscribers (each with one share) are:—H. W. Gorringe, 19, Hotham Villas Road, Putney, S.W., clerk; F. Alexander, Powis House, Dagnall Park, Selhurst, S.E., accountant; Lavinia Williams, 51, Chatham Place, Hackney, typist; G. Hearsey, 3, Harod's Place, Well Street, E., warehouseman; S. R. D. Thorpe, 6, Copthall Avenue, E.C., solicitor; C. B. King, jun., 2, Hampstead Mansions, Hampstead, electrical engineer; and E. R. Smith, Emsdene, Water Lane, Cricklewood, N.W., electrician. Table "A" mainly applies. Registered office, 103, Queen Victoria Street, E.C.

British Electric Street Tramways, Limited (67,494).—This company was registered on October 18th, with a capital of £300,000 in £10 shares, to construct, equip, maintain, and work electric tramways, electric railways, vans, carriages, launches, steamboats, and other vehicles, or other means of conveyance by land or water, and to carry on the business of electricians, mechanical engineers, machinists, fitters, founders, millwrights, smiths, wire drawers, tube makers, japanners, annealers, platers, saddlers, rubber manufacturers and merchants, oil refiners, tool makers, ironmongers, &c. The first subscribers (each with one share) are:—F. Howard, 65, Digby Road, Brownswood Park, N., clerk; F. Hopkins, 29, Heron Road, Herne Hill, S.E., shorthand writer; O. M. Bolton, 431, Liverpool Road, N., clerk; C. M. Murphy, 31, Victoria Road, Chelmsford, shorthand writer; H. J. Taylor, 4, Greville Road, Walthamstow, N.E., clerk; H. E. Hill, 182, Leander Road, Brixton Hill, S.W., accountant; and R. M. Albery, Bowery Farm House, Wraysbury, Buckinghamshire, farmer. The number of directors is not to be less than three nor more than six; the subscribers are to appoint the first; qualification, £200.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Langdon-Davies Electric Motor Company, Limited (55,830).—This company's annual return was filed on August 31st, when 15,850 preference and 44,007 ordinary shares were taken up out of a nominal capital of £70,000 in 20,000 preference and 50,000 ordinary shares of £1 each; £1 per share has been called up on the preference and 4,007 ordinary shares, resulting in the receipt of £19,857; £40,000 is considered as paid on the remaining 40,000 ordinary shares.

SUPPLY STATION ACCOUNTS.

Leicester Corporation Electricity Accounts.

The accounts for last year of the electric supply department of the combined gas and electric lighting undertaking of the Leicester Corporation show that, despite the disadvantages which necessarily arise when the businesses are run as a joint affair, the supply is being well supported and extended. During the year over £23,000 was spent on extensions. Over 15,000 additional equivalent lamps were connected, and the maximum load increased by over 30 per cent., while the units output rose by over 40 per cent., showing that the consumers coming on are drawn from a remunerative class of customer. There is as yet no attempt at public lighting. This is to be regretted, because it leads rather to the opinion that gas is considered good enough, because gas is the dominant partner.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£81,679	**£104,722**	£23,043
Number of units sold	386,186	**566,600**	180,414
Number of lamps connected ...	37,240	**52,526**	15,286
Maximum load in KW.	670	**880**	210
Gross revenue	£8,920	**£10,915**	£1,995
Gross expenditure...	£3,917	**£4,757**	£840
Gross profit	£5,003	**£6,158**	£1,155
Average price per unit sold ...	5·00d.	**4·21d.**	—·79d.

The receipts per unit for energy in 1898 stood at 5d., a figure also holding in the previous. In the first half of last year the charges were 5d. and 2d., and in the latter half 4d. and 2d. The result of the reduction appears in the increased output, but is also indicated by the fall of about ¼ths of a penny in the revenue, the average now being 4¼d. per unit, a substantial reduction. A good deal has been heard from time to time about the wiring and fitting business of the Corporation, and how it is objected to by the local contractors. This work is represented by the sums of £611 and £640 respectively as profits arising therefrom and included in the revenue statement in this form only. Further particulars are not given in the printed accounts, so one is unable to say what percentage these figures show on the year's turn-over.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy, &c.	£8,043	5·00d.	**£9,952**	4·21d.	—·79d.
Meter rents	234	·14d.	**323**	·14d.	·00d.
Profits—Fittings department	611	·38d.	**640**	·27d.	—·11d.
Interest received	32	·02d.	....	...	—·02d.
Gross revenue ...	£8,920	5·54d.	**£10,915**	4·62d.	—·92d.

Where coal is bought in large quantities and is not loaded with heavy freight charges the increase in cost per ton is a large fraction, and as one would expect at Leicester, the upward tendency on the coal market has added $\frac{1}{10}$d. per unit on the coal bill. The figure of ·58d. is not at all out of the way, however. Oil, waste, &c., has slightly risen, but all the other figures are reduced, particularly salaries and wages and repairs. It is interesting to examine the Leicester figures closely, as they relate to a station where, we believe, there are four equal sets of 400 KW. each. The troubles of a technical character experienced at Leicester were common talk a year or two ago. The results now seem to show that these have been got over entirely.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal, and unloading same .	£786	·49d.	£1,367	**·58d.**	+·09d.
Oil, waste, water and engine room stores.	243	·15d.	393	**·17d.**	+·02d.
Salaries and wages incurred in generation and in distribution.	1,419	·88d.	1,433	**·61d.**	—·27d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	685	·43d.	761	**·32d.**	—·11d.
Works costs ...	£3,133	1·95d.	£3,954	**1·68d.**	—·27d.
Rent, rates and taxes ..	305	·19d.	354	**·15d.**	—·04d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	254	·16d.	206	**·09d.**	—·07d.
Establishment charges, stationery and printing, law charges and insurance	225	·14d.	243	**·10d.**	—·04d.
Other expenses	...	...	...	...	...
Total costs ...	£3,917	2·44d.	£4,757	**2·02d.**	—·42d.

The financial charges in 1898 amounted to £4,312 and in 1899 to £4,731. As, however, the gross expenditure only rose to £840 for an increase in revenue of £1,995, there was an extra £1,155 to meet the difference in financial charges, and to add to the net profit, which more than doubled.

Profit Statement.

	1898.	1899.
Interest on loans, to bank and on deposit	£2,176	£2,595
Sinking fund for repayments	2,136	2,136
Net profit carried forward	691	1,427
Gross profit	£5,003	£6,158

Ayr Corporation Electricity Accounts.

The accounts of the municipal electricity supply undertaking at Ayr show that the financial position is improving, although the business has not yet reached the position of paying its way and meeting all the charges. In 1897 the deficit amounted to £1,155; the next year this figure had fallen to £747, while last year the net loss was £696. From the general statement it will be seen that the extensions are only proceeding slowly, the increase in capital expenditure being less than £3,000, but the rise in output is satisfactory for a town situated as Ayr is, and subject to rather peculiar local conditions.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£43,897	**£46,865**	£2,968
Number of units sold	297,420	**425,639**	128,219
Number of lamps connected ...	11,950	**17,912**	5,962
Maximum load in KW.	210	**256**	46
Gross revenue	£3,901	**£5,245**	£1,344
Gross expenditure	£2,621	**£3,480**	£859
Gross profit	£1,280	**£1,765**	£485
Average price per unit sold ...	3·08d.	**2·85d.**	...

The gross receipts have been swelled by about 30 per cent., and now stand at over £5,200. The effect of the scale of charges adopted has been to reduce the revenue from sales of electrical energy by nearly ¼d., the figure of 2·85d. per unit average received

by connection to the lamp circuit of the car. Its energy

the managing director; qualification, £50; remuneration as fixed by the company. Registered office, Vron Haulog, Colwyn Bay.

from this source being extremely moderate, and which should have the effect of creating a steady and increasing demand. Of the total of 425,639 units, private consumers took 168,039 only, while the public lamps (82 arc lamps and 117 incandescents) consumed no less than 257,600 units. On the gross receipts per units there is a drop of nearly ⅛th of a penny, or ·03d. per unit more than the change in total cost.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£3,812	3·08d.	**£5,056**	2·85d.	—·23d.
Meter rents, &c.	2	...	**16**	·01d.	+·01d.
Sale of old material	87	·07d.	**173**	·10d.	+·03d.
Other: income-tax, rents, &c.	...	...	...	...	...
Gross revenue ...	£3,901	3·15d.	**£5,245**	2·96d.	—·19d.

The cost sheet shows the effect of increased price for fuel, which was ·68d. in 1897 and in 1898, and is now ·72d. Establishment charges have gone up slightly, while oil, waste, &c., and salaries remain unaltered; the other items having fallen, the most important alteration being in wages, the change in which shows that Mr. Fuller, the engineer, is running the works as economically as possible. The reduction in total costs to below 2d. is good under the circumstances.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal and unloading same ..	£847	·68d.	£1,288	**·72d.**	+·04d.
Oil, waste, water and engine room stores, &c.	60	·05d.	83	**·05d.**	·00d.
Salaries and wages incurred in generation and distribution and attending street lamps	924	·75d.	974	**·55d.**	—·20d.
Repairs and maintenance of buildings, engines, boilers, dynamos and public lamps	211	·17d.	265	**·15d.**	—·02d.
Works cost ...	£2,042	1·65d.	£2,610	**1·47d.**	—·18d.
Rent, rates and taxes ..	107	·09d.	146	**·08d.**	—·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	299	·24d.	417	**·24d.**	·00d.
General establishment charges, stationery and printing, law charges and insurance	106	·09d.	262	**·15d.**	+·06d.
Other expenses; repairs to property	67	·05d.	45	**·02d.**	—·03d.
Total costs ...	£2,621	2·12d.	£3,480	**1·96d.**	—·16d.

Under the head of profits it may be noticed that the increase in gross profit, a sum of £485, is divided, £434 going towards the larger amount required to meet the interest and sinking fund charges, and £51 being the difference between the deficit in 1898 and last year. In a year or two we look for a clear financial statement when the whole of the charges will be met.

PROFIT STATEMENT.

	1898.	1899.
Interest on loans	£1,178	£1,531
Sinking fund for repayments	849	930
Net profit carried to rates	— 747	— 696
Gross profit	£1,280	£1,765

CITY NOTES.

The Western Telegraph Company, Limited.

THE directors' report for the half-year ended June 30th, 1900, to be submitted to the general meeting on October 30th, 1900, reads as follows:—

The directors submit the annexed accounts and balance-sheet for the half-year ended June 30th, 1900. The revenue for this period amounted to £230,434 19s. 9d., and the working expenses to £80,579 15s. 2d. After providing £11,031 12s. 4d. for debenture interest and sinking fund, and £3,210 5s. 7d. for income-tax, there remains a balance of £135,613 6s. 8d.; to this is added the sum of £6,790 19s. 6d., brought forward from December 31st last, making a total of £142,404 6s. 2d. A quarterly interim dividend, amounting to £31,189 10s. has been paid, and £50,000 transferred to the reserve fund. The directors now recommend the declaration of a final dividend of 8s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which, together will amount to £51,982 10s., leaving a balance of £8,571 0s. 8d. to be carried forward. The dividend and bonus will be payable on November 1st. The company has recently acquired an interest in the capital of the River Plate Telegraph Company, Limited. The directors of the Western Telegraph Company, Limited, will become directors of the River Plate Telegraph Company, Limited; a resolution to meet these cases is included in the notice convening the extraordinary general meeting. Under the powers vested in the board by the articles of association of the company an amount of £400,000 4 per cent. debenture stock has been constituted; of this amount £348,777 has been allotted to the late holders of the same amount of 4 per cent. debenture stock of the Western and Brazilian Telegraph Company in lieu of their being paid off at par. The balance remains at present unissued. Additional cables have been successfully submerged between Para and Rio de Janeiro, and are being continued from the latter city to Monte Video. The auditors, Messrs. Deloitte, Dever, Griffiths & Co. and Messrs. Gane, Jackson, Jefferys & Wells, offer themselves for re-election.

The Consolidated Telephone Construction and Manufacturing Company, Limited.

THE report of this company, to which we made a brief reference in our last issue, reads as follows:—

Your directors beg to submit the report and accounts for the year ending March 31st, 1900. Your directors point out that it was not until the end of October, 1899, that the new board were in a position to complete arrangements for re-organising the management both in London and Coventry. The results for the five months immediately following that date, and ending March 31st last, are very satisfactory as compared with the preceding seven months, the sales for the first-mentioned period showing an increase of over 56 per cent. above those for the corresponding months of the previous year. The steady increase in the business during the 12 months terminating September 30th, 1900, justifies the opinion regarding the prospects of the company which the new board held when, at the invitation of the shareholders, they undertook the direction of affairs. The directors, recognising that the accounts should be made up with due regard to the actual position of the company, have had the assets of the company re-valued where necessary, and the accounts as now presented set out the true position. The trading profit for the year amounts to £1,192 0s. 9d. (almost the whole of which was made during the last five months) and the total credits to revenue amount to £9,703 13s. 9d. Deducting the expenses, amounting to £2,386 8s. 2d., and including the amount brought forward from last year (£185 2s. 2d.), there remains, after writing off the sum of £4,334 8s. 4d. on depreciation account, a balance to the credit of profit and loss of £3,167 19s. 5d. The following dividends have been paid during the last seven years:—1893, 2 per cent.; 1894, 2 per cent.; 1895, 1½ per cent.; 1896, 1½ per cent.; 1897, 2 per cent.; 1898, 1½ per cent.; 1899, 1 per cent., being an average of £1 12s. 10d. per cent. Taking into consideration the conditions under which the year's trading has been carried on, the directors do not feel justified in recommending the payment of a dividend for the year ending March 31st, 1900; but the directors consider that the present position of the company justifies the payment of an interim dividend at the rate of 3 per cent. per annum for the first six months of the current financial year, and they propose to pay such dividend accordingly. The directors have reason to expect that in the near future this rate of distribution will be increased. Satisfactory arrangements have been effected with several of those railway companies with whom the company had not been able for some years past to do business, and many new accounts have been opened. The friction which for several years existed between your company and the National Telephone Company has been removed, the result being that orders have been received from that company, which your directors have every reason to believe will be increased in the future. Considerable orders have been received from the War Office and other Government departments; and arrangements have been made for developing the company's business in South Africa and the Colonies generally. The business of the Anglo-Portuguese Telephone Company has shown considerable expansion, and the directors believe that the position of that company can shortly be placed on a still more satisfactory basis, with consequent benefit to your company. The lawsuit initiated by the Edison-Gower-Bell Telephone Company against manufacturers in Belgium who have infringed that company's patents, has made satisfactory progress, and has entered upon its final stage, the appeal of the defendants having been decided against them. Mr. Henry Grewing resigned his position as a director in April last, and on the advice of Sir W. H. Preece, K.C.B., Mr. C. H. Reynolds, C.I.E., late Director-General of Telegraphs to the Indian Government, was elected in his place. Mr. Reynolds, in accordance with the articles of association, retires by rotation, and being eligible, offers himself for re-election. Colonel G. E. Gouraud has given notice of his intention to offer himself as a candidate for a seat on the board. At the request of the Shareholders' Committee of Investigation, appointed in 1898, the directors enclose a circular relative to one issued by Colonel Gouraud to some of the shareholders in July last. Your directors feel satisfied that the shareholders, having elected the present board so recently, will support their continued, and so far successful, efforts to bring the company into a satisfactory position, and they therefore request the return of the enclosed proxy, duly signed and witnessed, at the earliest possible date. The auditor, Mr. J. G. Griffiths, F.C.A. (Messrs. Deloitte, Dever, Griffiths & Co.), retires, and being eligible, offers himself for re-election.

Mr. H. F. Jackson presided over the nineteenth annual meeting of the shareholders of the above company held at Winchester House on Wednesday. There was a large attendance of shareholders, and at times the proceedings were somewhat lively.

The CHAIRMAN said that was the first time the new board had met the shareholders, and perhaps they owed an apology to them for not holding the meeting at an earlier date. As some of the directors joined the board so late, it was found impossible to hold the meeting before the Midsummer holidays. It was true that the articles of association said the meetings should be held in March, but they never had been held then, as the accounts were made up to March 31st. Another article said that the accounts should be made up to within three months of the holding of the meeting, but they would agree that under those rather exceptional circumstances it would be a mistake on the part of the board to make up the accounts to within three months of the meeting. When the directors came into power there was a large amount of back work to look after, and they decided to ask Mr. Kerr to take the position of managing director. Mr. Kerr was his brother-in-law, and the directors did not think that was any insuperable objection, and they elected Mr. Kerr to the position, and as far as they had been able to judge, the appointment had been attended with the happiest results. The most difficult matter they had to deal with was the management of the factory at Coventry, and they had obtained a very efficient manager in Mr. Dundas. They considered that the five months' working ending March 31st was satisfactory, and in that period practically the whole of the profit shown in the balance-sheet was made. He noticed that the old directors in their circular objected to that, but the directors were in the best position to judge of that. They had taken the steps necessary to value the assets, and they would notice the remarks which the auditors made upon them; but, of course, they could not look upon the auditors as actual valuers, and could not pretend to be able to judge whether the values were sufficient. The first question they called attention to was £4,200, a valuation of securities received in 1899, and attributed to arrears of dividends on shares in the Edison-Gower-Bell Telephone Company, which was taken from the suspense account and put to profit and loss. Those shares were exactly in the same position as the 80,000 5 per cent. preference shares in the Edison-Gower-Bell Company which they saw in the balance-sheet. They were identical with them in every respect, and they had received a dividend upon them. Therefore he did not see how it was possible to contest the right to put those shares in the profit and loss account at that figure. If that was wrong, then the entry of the 80,000 shares was wrong also. Then the auditors remarked on the appreciation of £300 in deben-

the Corporation, and how it is objected to by the local contractors.

energy by nearly ¼d., the figure of 2·85d. per unit average received

tures held in the Anglo-Portuguese Telephone Company. The company held first and second debentures in that company; the second debentures were valued at par, and all the directors had done was to value the first debentures at par. Then with regard to the question of the re-valuation of the private lines installation, he had only to say that the private lines returned a net profit which justified them in valuing them at the figure they had. The trading profit was £1,152 0s. 9d., which was satisfactory considering that in the past five years the average profits had been but £885. The profit shown in the revenue account would have been larger had it not been that during the transition stage they had had to pay double salaries to various officers and to pay £76, the balance of the expenses of the shareholders' committee. They had valued the stock at what they believed it to be worth. With regard to the proposal to pay an interim dividend, their justification was that they were prepared to take the responsibility, for they knew what the progress of the business was and what profits were being made. Their efforts to increase the company's scope had resulted in an order of a considerable amount being received from Australia. With regard to the Anglo-Portuguese Company, in which they were largely interested, he believed it was capable of giving much greater profits than in the past, and they had important negotiations in hand with the Portuguese Government, and with the Electric Tramways Company in Portugal with reference to their system. He thought the negotiations would result in something satisfactory to the company, and hoped to be able to report something definite at the next meeting. With regard to the old standing lawsuit with the Edison-Gower-Bell Company, the final stage had now been entered into, and they hoped to hear something of a definite nature before long. The company had hitherto restricted its sales to telephones and telephone apparatus, but having had inquiries with regard to electric lighting material, they thought it would be advisable to extend the operations of the company to enable them to carry out such orders, and they were making arrangements to acquire a considerable share in a business in London—a business which had shown a considerable profit, and whose profits were increasing day by day. That matter was not yet complete, and therefore he could not go into it. In conclusion, the chairman referred to the notice given by Col. Gouraud to stand for election as a director, and said it was a shabby thing for the old directors to try and embroil the company in trouble. He did not think the old directors ought to ventilate their grievances in the press, but should leave the new board at peace to carry on the work of the company.

Mr. C. Woolley seconded the motion.

Mr. Fitzgerald, the late chairman of the company, said the chairman had not replied to the questions of which he had given notice.

The Chairman said he would answer them. They were (1) Who sold the 300 Telatograph shares to the Consolidated Company? They would see the entry in the balance-sheet of £375 for that. They were original shares, and were not bought from anyone. As a result of that investment they had received a first order of £1,250. The second question was: "Did the company pay a dividend?" It did not. The third question was whether the company was in the Stock Exchange Year Book, and did it issue an annual report? The answer was yes. Fourth question: Who fixed the price of the shares at 1¼? The price was fixed by the two boards, and one of their old directors (Mr. Graving) proposed that the transaction be carried through. Fifthly, it was asked what agreements had been made for the payment of salaries to the manager and managing director. That was a matter of domestic management. He had answered the sixth question as to what relation Mr. Kerr was to him. The seventh question was whether a factory in London had been purchased, and he had told them all he could about it. Then it was asked what remuneration he got from the Consolidated Company, the Anglo-Portuguese Company, and the Edison-Gower-Bell Company. All he got was that provided by the articles of association. The total amount paid to the directors was £500. Mr. Fitzgerald then called for the factory accounts to show how the profit of £1,100 had been arrived at, but of course he could not agree to bring forward such an account or he would not be fit for the position he held.

Mr. Fitzgerald then addressed the meeting from the back of room, but he was so frequently interrupted by shareholders that it was difficult for the Press to follow exactly what he said. He said he called for the factory accounts, because it was the only way in which they could arrive at the profits. He had managed the business for a good many years (cries of "mismanaged"), but the directors said the whole of the profit was made in the last five months of the year. Mr. Fitzgerald proceeded to read a letter from Mr. Menzies, the late manager, to the effect that all the orders executed had come through him, and not through the new men. As a matter of fact, the new managing director got £850 a year for three years, and the manager £500 a year for five years. The old board had always held the £4,200 referred to in suspense, because they knew the Edison-Gower-Bell Company would never pay it. He had worked like a black for the company, but he would never go on a board again. They had been accused of leaving Col. Gouraud in the cold, but there was such a thing as getting hold of people and understanding them, and finding them not quite so awful as they thought they were. He would like to know what the £900 odd Edison-Gower-Bell preference shares meant in the revenue account.

The Chairman said it was dividend owing which had been paid up.

Mr. Fitzgerald moved: "That the report and accounts be referred back to the directors, with the request that the accounts be made up in the same manner as formerly, and submitted to an adjourned meeting one month from that date."

Mr. Baker seconded the amendment.

In the discussion which followed, the Chairman mentioned that the directors had received proxies representing 121,727 shares, against 21,000 for Col. Gouraud.

Mr. Griffiths, the auditor, explained his note to the accounts, which was to the effect that while he was frankly met by the directors on the matter, he had no means of telling whether the value placed on the shares was correct, and he considered it was his duty to call the attention of the shareholders and the directors to it.

The amendment was defeated by a large majority, and the report agreed to.

Cuba Submarine Telegraph, Limited.

Mr. C. W. Parish (chairman) presided on Wednesday morning over the 58th ordinary general meeting of the above company, held at the offices, 58, Old Broad Street, and in moving the adoption of the report, said that the traffic receipts, £13,177, showed a decrease of £5,646 as compared with the previous half-year. That was a serious falling off, but one which they would be prepared for, as he had clearly warned them at previous meetings that they were bound to lose the exceptional amount of business which the revolution and the Spanish-American war and Government business brought them, and that further they were bound to suffer for the low rates which competition and circumstances forced upon them. In addition to the traffic receipts of £13,177, they had £2,158 as interest on investments which gave altogether a total of £15,336. The expenses had been £6,296; they had carried £2,000 to reserve fund; the dividend on preference shares required £3,000, and from the balance they were able to pay a dividend at the rate of 5 per cent. per annum on the ordinary shares, leaving £5,204 to carry forward to the next half-year as compared with £5,165 brought forward from December, 1899. Their expenses were £961 less. Their claim of £8,174 for damage to cables during the Spanish-American War, was still outstanding. He had unfortunately no definite news to tell with regard to that claim or their concession or general position with the Government of the United States. The negotiations of Her Majesty's Ambassador with the United States Government were still proceeding, but he felt that until the American elections were over and the President was elected they could not hope for any definite news. It was somewhat discouraging to those who were in business to have to meet these long delays, but they must remember that the United States Government and the Cuban authorities had still many points of the greatest importance to settle as to the future government of the land, and he understood that for the present their hands were very much occupied, and he was afraid their smaller claims did not get the attention they deserved. It was, of course, very hard that they should not be paid the subsidies due for the coast cables, and they would be very disappointed if that matter was not settled before long, for they ought to receive about £3,000 for the subsidies for the three half-years due to them. He would not say much with regard to the lawsuit with the West India and Panama Company, as it would again come before the Courts. The decision of the High Court was completely in their favour, but the West India and Panama Company had given notice of appeal, and the case would come on again at the end of the year or early next year.

Mr. George Keith seconded the motion, and it was carried.

A Shareholder called attention to the large reserve, and said that the old chairman of the company used to tell them that £100,000 would be sufficient. They had now a considerable increase on that, and he asked whether their dividends ought to be reduced, so that such a large sum could be added to reserve.

Replying to this, and other questions, the Chairman said that since the old chairman made the statement about the reserve fund, they had greatly increased their responsibility, for they had the coast lines, and in addition to that, their cables did not get any younger. He thought they could trust the board to pay as good a dividend as they felt was justified. As to the condition of Cuba, things seemed to be in a mess, although it was said that they expected a good sugar crop.

Electric Street Car Syndicate.

On 17th inst. an extraordinary general meeting of the Electric Street Car Manufacturing Syndicate, Limited, was held at the registered office of the company, Wednesfield Road, Wolverhampton, when the following resolution was adopted:—

That an agreement dated the 6th day of October, 1900, and made between the company of the one part and the Electric Tramway Maintenance and Construction Company, Limited, of the other part, for the sale of the company's business be and is hereby approved.

The business, which has now been sold, was established about three years ago, for the manufacture of motor-cars, and attention has since been turned to electric tramcars and tramway appliances. But the Tramway Maintenance Company, who are a London syndicate, hope, in regard to electric trams, to carry matters far beyond the experimental stage. It is believed that they will buy 20 acres of land at Wednesfield for the purpose of extending the works. Mr. Thomas Parker, who was chairman of the Electric Street Car Syndicate, will join the Electric Tramway Maintenance Company.

Monte Video Telephone Company.

The report for the year ended July 31st, to be presented to the meeting to be held in London on 31st inst., states that there is a net profit for that period of £9,270, after providing for all working

expenses in Monte Video and London, and for depreciation of stock of materials. To this should be added £2,258 brought forward, leaving £11,528. From this the directors propose to transfer £3,500 to reserve fund, and they recommend that, after payment of the full dividend at the rate of 5 per cent. per annum upon the preference shares, a dividend at the rate of 2½ per cent. per annum be paid upon the ordinary shares, and that £1,886 be carried forward.

Stock Exchange Notices.—The committee has appointed a special settling day as under:—Tuesday, November 13th: Telegraph Manufacturing Company, Limited, further issue of 5,000 shares of £5 each, fully paid, Nos. 20,001 to 25,000; and has ordered the undermentioned securities to be quoted in the Official List:—Folkestone Electricity Supply Company, Limited, 10,000 ordinary shares of £5 each, fully paid, Nos. 1 to 10,000; National Telephone Company, Limited, £500,000 4 per cent. debenture stock; Telegraph Manufacturing Company, Limited, further issue of 5,000 shares of £5 each, fully paid, Nos. 20,001 to 25,000.

Prospectus.—The list closed yesterday in an issue of 19,900 6 per cent. cumulative preference shares of £5 each in the Electric and General Investment Company, Limited. The present issue is made to provide the additional capital rendered necessary by the steady increase of the company's business, especially in connection with the great development which is taking place in electric tramway and railway undertakings. The 19,900 shares are the remaining unissued shares of the company, which have now been issued as preference shares with special preferential and other rights.

The Submarine Cables Trust.—It is announced that, in accordance with the terms of the trust deed, tenders are invited from the certificate holders of certificates to be redeemed out of surplus income, accrued to October 15th inst., at a price not to exceed £120 per certificate, the certificate holder retaining the coupon of reversion attached to any certificate which may thus be redeemed.

The Calcutta Electric Supply Corporation, Limited.—The directors have declared an interim dividend on the share capital at 3 per cent. per annum for the half-year ending June 30th last.

City of London Electric Lighting Company.—Letters of allotment in respect of the issue of £200,000 4½ per cent. second debenture stock, which was over-subscribed, have been duly posted.

Castner-Kellner Alkali Company, Limited.—The directors have decided to pay an interim dividend on the original capital, as well as on the new capital allotted to the shareholders of the Aluminium Company, at the rate of 8 per cent. per annum for the six months ended September 30th.

British Columbia Electric Railway Company.—The preference share registers will be closed against transfers from October 21st to October 31st, inclusive.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 20th, 1900, were £259; receipts for corresponding period, 1899, £325; decrease, £66. Total receipts to date, £18,663; corresponding period of last year, £18,633; increase, £30.

The Bristol Tramways and Carriage Company.—The receipts for the week ending October 20th, 1900, were £2,993 19s. 10d.; corresponding period, 1899, £3,060 19s. 9d.; decrease, £66 19s. 11d.

The Central London Railway.—The receipts for the week ending October 20th, 1900, were £5,465; previous week, £5,421; increase, £44. Total receipts to October 20th, 1900 (12 weeks), £58,396. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending October 21st, 1900, £1,708; October 22nd, 1899, £1,019; increase, £689. Total receipts for half-year, 1900, to date, £24,592; corresponding period, 1899, £15,254; increase, £9,338. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending Thursday, October 18th, 1900, were £410 6s. 1d.; corresponding week last year, £377 8s. 7d.; increase, £32 17s. 6d. Total to October 18th, 1900, £17,463 7s. 10d.; corresponding period last year, £16,009 16s. 1d.; increase, £1,453 11s. 9d.

The Dover Corporation Tramways.—The receipts for the week ending October 20th, 1900, were £198 0s. 5½d.; October 21st, 1899, £187 19s. 11d.; increase, £10 0s. 6½d. Total receipts to date, 1900, £8,875 0s. 2½d.; corresponding period, 1899, £8,463 4s. 1d.; increase, £411 16s. 1½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,966; 1899, 4,748. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 19th, 1900, were as follows:—D. U. T. Co., horse cars, £27 2s. 2d.; ditto, electric cars, £3,468 16s. 5d.; D. S. D. Co., electric cars, £749 16s. 6d.; total, £4,245 15s. 1d.; corresponding week last year—D. U. T. Co., horse cars, £705 6s. 0d.; ditto, electric cars, £2,301 14s. 7d.; D. S. D. Co., electric cars, £726 18s. 3d.; total, £3,735 18s. 10d.; increase, £509 16s. 3d.; aggregate to date, £78,548 9s. 4d.; aggregate to date last year, £70,370 9s. 5d.; increase to date, £8,177 19s. 11d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 39 miles electrically, 12 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 21st, 1900, were £1,594; corresponding week last year, £1,571; increase, £23. Total traffics from July 1st, 1900, £27,376; ditto corresponding period, 1899, £26,174; increase, £1,202. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

It was at first supposed that the new Anglo-German agreement would have been hailed by the Stock Exchange with a rapturous rise in all the investment markets. The expected did not happen, however, and although there has been a fair demand for gilt-edged stocks during the week, very little fluctuation in prices has ensued. Dealers in Electric Supply shares have been busy with Debenture dealing, and again we have to record the steady strength of this section. In connection with this, we do not think we are exposing any State secrets in mentioning that the City of London Company's issue of £200,000 in 4½ per cent. second Debentures, was publicly subscribed to the extent of £183,000. The remainder was taken privately, as no underwriting was done. The City company is fully entitled to congratulate itself upon the result achieved.

New issues are again in the air. The Chelsea Electric Supply Company is about to invite subscriptions for fresh capital to the tune of £84,000. The issue will be made in 14,000 Ordinary shares of £5 each, offered *pro rata* (about one new for three old) at £6 per share. Chelsea Ordinary standing at 7 in the market, this will provide a bonus of 5s. or 6s. per share to Chelsea proprietors. The price of the old still carries the "rights," although the books of the company were closed on Tuesday night.

Charing Cross Preference shares are ¼ better, otherwise the list of shares is unaltered since last week. There has been a tendency to sell Westminsters, but the price is not affected. City of London 5 per cent. Debenture script is a point to the good on the success of the junior stock's issue. Brush Ordinary and Preference have declined on sales by a few speculative holders who got tired of hoping to see the price improve upon its recent advance.

As regards the telegraph market, a somewhat sensational collapse in the Anglo-American Telegraph Company's stocks is the principal feature. The Preferred has been the chief sufferer, and the quotation exhibits a drop of no less than 6 per cent. on the week. This is attributable to a semi-scare that has seized holders, who, seeing the price of the Anglo-American Deferred falling away, took fright, and gave orders for their "B" stock to be sold at best. After its slump we are inclined to consider Anglo-Preferred cheap, and if a sharp reaction does not set in, it will be surprising. "Directs" are also down, but the fall in this case has not exceeded ¼. Possibly the fear of the new German competitor may turn out to be worse than the actuality.

Eastern Ordinary is better, the Anglo-German agreement pacifying the market, and Eastern Extension Debenture stock has been in request. Western Telegraph shares are ¼ off, notwithstanding the company's report, which is quite satisfactory. In the telephone list Nationals are still 4½, and as a speculative investment, we would again call attention to the company's prospects. The 3½ per cent. Debenture stock is a point down, but the Preferences do not move. A battle royal is going on within the ranks of the Consolidated Telephone Construction and Manufacturing Company. The *fracas* is regarded in the Stock Exchange as more or less of a personal affair between the present directors and their predecessors, and the price of the shares keeps in its lowly confines of 4s. to 5s. Amongst other miscellaneous companies' items of interest, we may mention that the Electric Investment and General Company wants £99,500 in 6 per cent. Preference shares. The money is required more especially for the development of the company's electric tramway and railway undertakings.

It is distinctly amusing to find several of the most influential dailies informing their readers that Marconi's Wireless Telegraph shares have just been placed on the market at about £3 10s. For the last 18 months we have been keeping our readers in touch with the movements in this dark market, but the spontaneous way in which our contemporaries have mentioned the "new introduction" to the market makes us wonder whence they drew their unanimous inspiration.

Babcock & Wilcox, to which we called attention last week, are up ½, and Telegraph Construction have risen £1. British Insulated Wire, on the other hand, are down a point. The traction market continues stale, and there is nothing noteworthy to record in connection with electric railway securities. The Central London's traffic of £5,415 for the week is the best taken since the opening of the line.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation October 17th.	Closing Quotation October 24th.	Business done during week ended October 24th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	56 — 59 xd	54 — 57	56½	55
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	105½-106½xd	99½ 100½	105½	100
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10½— 11	10½— 10⅝	10⅝	10 9/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	101 —103	102½	101
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	7¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 —104 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10½— 11 xd	10¼— 10⅜	10⅜	10⅜
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	148 —153 xd	149 —154	152	149½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102 xd	99 —102	101	99½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	115 —120	115 —120	118	117½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15 —15½ xd	14⅜— 15¼	15¼	14⅞
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	113 —118	114 —119	115½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	5¼%	10⅜— 11¼	10⅜—11¼	11 1/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15⅜	15⅛
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	32 — 34	32 — 34	32	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	49 — 53	52	51¼
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	2½%	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅜— 4⅝	4⅜— 4⅝	4 9/16	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	13	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	96 —99	98	97
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8 xd	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129 xd	124 —129	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5¼	4⅜— 5¼	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,071—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜— 15½	14½—15	14⅜	14⅜
75,000	Do. do. 5 % Debs. 2nd series, 1905 ...	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	⅜%	2 %	⅜%	⅜— 1	⅜— 1	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	103⅜	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10	9 — 10	9 13/16	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 6	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6½— 7½	...	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	110 —113	110 —113	111⅜	111
60,000	City of London Electric Lighting, Ord. 40,001—100,000...	10	10 %	6 %	4 %	8 — 9	8 — 9	8½	8½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½—13½	12½— 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	124 —129	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	9	8 1/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	11⅜	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	108 —112	...	...
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅜— 2¼	1⅜— 2¼	2 1/16	2
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5½	4½— 5½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13½— 14½	14⅛	13¾
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	98½	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½— 15½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 —95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 4	2½— 3½	...	...
70,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅜	12¼

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Oct. 17th.	Closing Quotation Oct. 24th.	Business done week ended Oct. 24th, 1900. Highest	Lowest
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	9 — 10	9 — 10	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	93 — 97	93 — 97	...	...
30,000	British Electric Traction	10	...	6 %	...	13½— 14½	12½— 13½	13⅜	13¼
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12 7/16	12⅛
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	122	120½
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜— ½	⅜— ½	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	⅝— ¾	⅝— ¾	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000 ...	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝— 2	1⅝— 1⅞	1 1/16	1⅝
105,731	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2⅛— 2⅜	2 — 2¼	2⅛	2 1/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	102 —104	102 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	12½— 13½	12½— 13½	13¼	12¾
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5½	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	10 — 10⅛	10⅛	10⅛
61,033	Do. do. Pref. half-shares	5	...	...	...	5 — 5½	4¾— 5¼	5¼	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5 5/16	5¼
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	58 — 61	58 — 61	59	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 6	5 — 6	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3¾— 4¼	3¾— 4¼	3 1/16	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅜— 2¼	1⅜— 2¼	1 1/16	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3¼— 4¼	3¼— 4¼	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	91	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2 1/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2¾— 3¼	2¾— 3¼	...	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	104	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½— 13½	12½— 13½	13	12¾
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5 — 5½	5 — 5½	5⅜	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20 — 21	20 — 21	...	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3¾%	8¾— 9	8¾— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	13 — 13¼	12¾— 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 38	35 — 39	37½	35½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...%	101 — 104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½— 11½	10½— 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5 — 5½	5 — 5½	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	94 — 97	94 — 97	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4¼ % Debentures of £100, 103—106.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—10¼.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6⅞—7⅛. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17⅞.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, October 24th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	23/-	23/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160°C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	62/-	2s. inc.
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £145	£80 to £150	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c „ Tube (brazed)	per lb.	10d.	10d.	..
c „ „ (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c „ Wire, basis	per lb.	8¾d.	8¾d.	..
c Copper Tubes (brazed)	per lb.	11½d.	11½d.	..
c „ „ (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c, *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g „ Rod	per ton	£85	£85	..
e „ (Electrolytic) Bars ..	per ton	£88 10	£88 10	..
e „ „ Sheets ..	per ton	£92	£92	..
e „ „ Rod ..	per ton	£85 10	£85 10	..
e „ „ H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	4/- to 4/1	4/2½	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	67/9	67/9	..
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i „ Wire, galvanised No. 8 ..	per ton	£12 5	£12 5	..
g Lead, English Ingot	per ton	£17 12 6 to £17 15	£17 15 to £18	dec.
g „ „ Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 5	£9 2 6	2s. 6d. inc.
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/3 to 7/8	3/3 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ „ strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£132 to £133	£134 to £135	£2 dec.
g „ foil	per lb.	2/-	2/-	..
n „ wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j „ Best Flax, 6 lea.	per lb.	6d.	6d.	..
j „ Hemp, 8 ply 10 lbs. ..	per lb.	4¼d.	4¼d.	..
j „ Russian, 10 lbs. ..	per lb.	5¾d.	5¾d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ord.)	per ton	£24 5 nett	£24 5 nett.	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

THE LONDON COUNTY COUNCIL AND ELECTRICAL MATTERS.

The exhaustive address which has just been delivered by Mr. W. H. Dickinson, chairman of the London County Council, deserves attention at the present time in view of the various electrical questions which come within the province of the central administrative authority of London. The address, an abstract of which is given below, voices the principles which the County Council has decided to adopt in regard to the construction of new electric tramways, and it suggests the possibility of the Council overriding the veto of local authorities in relation to tramways, points out the intention of the Council to obtain legislative powers to deal with the supply of electricity in bulk, and concludes by hinting that the National Telephone Company is now sorry that it did not reduce the rental charges at the instance of the representations made by the Council, and thus avoid the competitive system of the Government now about to be introduced. The abstract is as follows:—

The Principles of Tramway Construction.

Since the Council has become possessed of the tramways it has become evident that in many parts of London the necessary development of these means of locomotion can only be effected in connection with considerable widenings of streets, and much negotiation has passed between these two Committees (Highways and Improvements) upon this subject. An important question of principle had first to be discussed with regard to the cost of these improvements, and it was ultimately settled that each proposal should be placed in one of three classes. First, improvements necessary for the purposes of street traffic alone, apart from any tramway traffic, the cost of which should be charged wholly to the Improvements Committee; secondly, improvements necessary to meet the needs partly of the general traffic and partly of the tramway traffic, and of this the cost would be divided between the two Committees; and, thirdly, improvements necessary only for the tramway, the cost of which is to be borne entirely by the tramways undertaking.

Under this arrangement the Improvements Committee have recommended the widening of Blackstock Road, Islington, and Harleyford Street, Lambeth, at the sole cost of the tramways undertaking, and the widening of St. John Street, Clerkenwell, and High Road, Streatham, the tramways undertaking paying one-half the cost of acquiring the property. A similar treatment was accorded to the proposals for constructing light railways, and of these the Committee submitted improvement schemes for Archway Road, Islington; West Hill, Wandsworth; Shooter's Hill Road, Blackheath; and Lewisham High Road, the cost being in each of these cases divided between the Improvements Committee and the tramways undertaking. In most of these improvements there are properties along the road of which only a portion of the garden or forecourt is required to be taken, and the Council decided to ask Parliament to make a special provision in these cases for releasing the Council from the ordinary obligation of taking the entire property when any part of it is touched. This provision is not only reasonable but absolutely essential if any extensive scheme for new tramways or light railways in London is to be carried out, except at a prohibitive cost, and I am glad to say that Parliament has acceded to the Council's contention. In the case, however, of the applications for light railways, it seems that the Railway Commissioners, to whom these proposals have to be submitted, are not empowered to give a similar exemption, and accordingly the schemes as laid before the Commissioners did not contain any reference to the widenings. The result of this was unfortunate, as the Commissioners decided that, as the proposals were not complete in themselves, it was impossible for them to approve the scheme.

The management of the existing horse tramways, important though it is, forms but a very small part of the problem which the Highways Committee has to solve. It has two very difficult and very urgent questions to deal with. First, the extension of tramways to meet the needs of this ever-growing city; and secondly, the adoption of electric traction, which has elsewhere been proved beyond doubt to be more rapid, more efficient and more economical than the older system. It would weary the Council were I to attempt to give in detail any account of the various lengthenings, widenings and doublings proposed by the Committee and included in the Bills for the Parliamentary session that has just passed. It suffices to say that the total addition to tramways, including those proposed to be made under the provisions of the Light Railways Act was no less than 25 miles. This might appear to many people to show a superabundance of energy on the part of the Committee; but it must not be forgotten that during the last 10 years the development of tramways in London has been at a standstill, and that with our rapidly growing population there is an immense amount of leeway to make up. Unfortunately, the Council has succeeded in carrying through only a very small portion of this programme, namely, about five miles out of the 25. In a very few instances this has been due to failure in making out a strong enough case to overcome the objections of frontagers and others before the Committees of Parliament; but the greatest cause of our failure has been due to the opposition of some of the local authorities of London.

The Veto of Local Authorities.

As the Council is aware, it is impossible even to lay before Parliament a Bill for a new tramway without having previously obtained the consent of the local authority, *i.e.*, the Vestry or District Board of the locality in which the tramway is to be laid. However good or necessary the proposal may be, if the Vestry says No! the Council can proceed no further. The result is that, although it is essential to connect the suburbs of London with the centre, if one intermediate locality objects to having a tramline laid through it, the whole scheme is impracticable. One would not object if the question could be properly fought out and argued before Parliament, but this stage can never be reached under the present standing orders of the House of Commons. This power of the local authorities has compelled the Council to drop nearly one-half of the proposed new tramways. I need hardly comment upon this fact; it reveals a serious state of affairs. If this Council, representing the whole of London, and charged as it is with the duty of developing the tramway accommodation so as to meet the needs of the whole of London, is to be prevented from carrying out its obligations solely by what I may call the selfish view of a particular locality, there must be an end to all improvement in the means of locomotion afforded to our people. Such a state of things cannot last. Either the local authorities must be induced to view this question from a broader point of view than hitherto, or Parliament will, I have no doubt, agree that the power of veto must be withdrawn from them. I trust, however, that the common sense of the new councils which are to be elected next month will prevail, so as to ensure to this Council a more reasonable consideration of the great question of metropolitan tramway accommodation than that given last year by some of the vestries and boards which are now passing out of existence.

Electric Tramways.

Although the actions of the local bodies have interfered with the extension of tramways, the Highways and Parliamentary Committees have found a means of passing through Parliament a measure which will enable the Council to proceed with a most important question, namely, the conversion of the system on existing lines to that of electric traction. The Council will be able, within a very short time, to set about establishing electric tramcars on some 115 miles of lines, and London is therefore within sight of a practical experience of this new system which so many other towns have long ago proved to be the most effective and the most economical. The Committee has been giving a great deal of attention to the question of what is the best system of electric traction to adopt, and in this have been materially assisted by Dr. Kennedy, whose special experience and wide knowledge of the subject have been placed at the disposal of the Council.

The Committee has, as I have already stated, also attempted to make use of the Light Railways Act in order to obtain powers to construct electric tramways, being of opinion that it would be less difficult and less costly if this could be done in lieu of making applications to Parliament. These applications have, however, unfortunately failed, by reason of the fact that in respect to many of these lines the Council has rightly insisted that in the numerous cases where the widening of the road only necessitates taking a small portion of the garden or forecourt, the public should not be mulcted by the usual provision enabling the owner to demand that his entire property should be taken. In order to achieve this result the Committee were advised that the proposals for widening the roads along which it was proposed to run the tramways should be included in an Improvements Bill. The effect of this division of the subject has been that the Railway Commissioners decided that, as the widenings were not before them, they could not consider the scheme as being sufficiently complete for adjudication. I fear that this decision will render it obligatory on the Council in future to proceed by Bill only; but possibly the Committee may yet find a way out of the difficulty.

Electric Lighting.

In connection with its duties respecting the supply of electric light, the Committee has had to take proceedings against two companies for failure of supply. In the case of the Metropolitan Electric Supply Company, repeated interruption in the illumination had caused immense inconvenience to the residents in Marylebone. The company admitted the failure, but pleaded that the causes of it were beyond their control, and the magistrate accepted the company's view and only inflicted a nominal penalty. In the second case, that against the London Electric Supply Corporation, the Council was unsuccessful before the magistrate, and the question whether the magistrate's decision shall be appealed against is still under consideration. (The appeal has now been abandoned).

No less than 12 applications were made to the Board of Trade in 1899 for electric lighting provisional orders, of which five were on behalf of local authorities and seven by companies. An important question had been raised in Parliament in 1898 as to whether, in cases where an existing company had rights of supply, a local authority should be permitted to compete. The Highways Committee took the view that the Electric Lighting Act, 1888, intended that such competition should be allowed, and the Board of Trade adopted this opinion, and although the proposals of the local authorities did not pass Parliament in 1898, they have been accepted in 1899.

Supply of Energy in Bulk.

The question of what the Council can do in regard to the subject of the supply of electricity in bulk is still under the consideration of the Committee. It will be remembered that Parliament has established certain companies with power to supply in bulk to local authorities and others concerned in providing light or power, and has also refused to place these companies under the operation of any purchase clauses in favour of the public similar to that which the electric lighting companies are subjected to. However, both the Joint Committee of Lords and Commons, which sat in 1898, and the Committees of Parliament that have dealt with the specific Bills, have intimated that this question should be properly settled by an application by some body representing the public in London for powers to supply electricity in bulk, and sooner or later action in this direction must be taken, as, if not, the public will before long find itself at the mercy of certain companies which are subject to none of the restrictions or liabilities which are at present imposed upon the ordinary electric lighting company.

The Telephone Problem.

Another subject of vast importance to London is the telephone service. A very considerable portion of the time of Mr. Benn and his Committee has been taken up with an unceasing struggle with the National Telephone Company. I will not enter into the details of the dispute. It suffices to say that some years ago the Highways Committee were led to the conviction that the telephone service in London was far less efficient and far more expensive than such service would have been if based upon the reasonable cost of constructing the system; and that Londoners were being made the victims of a company whose capital had been unduly inflated by various financial operations with which London had had nothing to do. They accordingly attempted to come to some agreement with the company under which the latter should have the advantage of an underground system, and in return should reduce its charges to the telephone users.

This arrangement the company refused to entertain, and in view of the march [of events since then, I have a shrewd suspicion that they must now regret their refusal. As no arrangement was possible, the only course the Committee could take was to use its influence to induce Parliament to approve of a system of direct competition, and now, by an Act of last year, the Post Office is empowered to establish a system of its own in London, and the works for this purpose are, I understand, approaching completion. When this is done the National Telephone Company will probably be compelled to reduce its charges quite as low as it would have had to do had it accepted the original proposal of the County Council.

RADIO-ACTIVITY.*

Of the numerous subjects studied by physicists during the closing century, few have experienced such marked contrasts of distinguished favour and absolute neglect as has that of electrical discharges in rarefied gases. The most important phenomena of these discharges were so far removed from the field of knowledge of the older explorers, even of the great Faraday himself, that they appeared to lie in a distant country, seen from afar, but unvisited. About 1869 Hittorf, exhausting his tubes more perfectly than any previous experimenter, saw the phenomena greatly simplified, and was the first to form an idea of the mode of operation of discharges in the interior of tubes. In the interval between Hittorf and Crookes, less than a decade, the progress made was considerable, and we now find one group of the phenomena completely surveyed, and their relations to other facts and other theories established. Of these theories some, such as the kinetic theory of gases, have been more generally disputed in proportion as they explained a larger range of facts. One theory in particular, proposed at this time, was based on a simple and clearly described idea, with the consequence that while none but physicists had noticed the work of Hittorf, that of Crookes appealed to the imagination of many persons in whose minds the notion of a fourth state of matter took rank at once as a precise, indeed, far too precise, conception.

Another period of inactivity ensued. Some physicists followed with interest, though without enthusiasm, the patient researches of Goldstein, and of Wiedemann and his pupils, and hailed with pleasure, in some of Hertz's experiments, the dawn of a new era of discovery. The inquiries of his most distinguished pupil, M. P. Lenard, brought to light some very curious facts, which, in his opinion, contradicted the theory of Crookes. From this time date

* Translation of the preface by M. Ch. Ed. Guillaume to the French edition of "Electrical Discharges in Gases," by Prof. J. J. Thomson.

the earliest experiments of J. J. Thomson, whose contributions to this subject are of the first order of importance.

One may recall the bewilderment—the word is not exaggerated—of physicists when the memorable experiment of Röntgen was announced, which enlisted at once hundreds of adepts in the study of electrical discharges in gases, and by one impulse advanced it farther than could have been hoped for from years of patient research. At the same time the practical applications of the experiment, and its quasi-commercial character, placed unexpected resources at the disposal of experimenters. Two figures will give an idea of this. At the end of 1896 the most powerful apparatus producing Röntgen rays could only feebly blacken a photographic plate through the flesh of the hand with half an hour's exposure, while to-day ten seconds will give a radio-graphic picture of the whole skeleton and cavity of the chest of an adult.

The study of the discharges in the gases themselves, independently of their effect outside the tube, advanced *pari passu* with that of Röntgen rays. Progress in the study of the latter being assured by their practical importance, the most distinguished experimenters soon returned to the primitive phenomena, which, originating at the cathode, are stopped by the walls of the tube, and that whether they strike the wall directly, or whether an obstacle stops them, or sends them off in a direction normal to its surface, as has been shown by M. P. Villard.

Some of the ideas to which most importance has been recently attached are not entirely new. Thus the question of the relation between the charges, and the masses which carry them, was raised in the old work of MM. Schuster and Giese. Prof. J. J. Thomson has carried this inquiry beyond any of his predecessors, and has arrived at the astonishing conclusion that the ratio is the same for all elements composing the cathode ray, whatever be the gas contained in the tube, a view which tends to regard all molecules as separable into similar elements. If one can follow the inverse path, and reconstitute from highly rarefied elements any form of matter, the possibility of transmutation, at least for very small quantities, is obvious.

But Prof. Thomson's curious results may admit of another interpretation. "Is it not possible," M. Villard asks, "that an exhausted tube always contains the same body, whatever gas is intended to be enclosed?" Some ingenious experiments show this to be very probable. The cathode rays are always powerful reducing agents, and may be constituted in every case of hydrogen, sensible quantities of which may be obtained by decomposition of water adhering to the walls of the tube.* This answer is not conclusive, but Prof. Thomson's interpretation is so startling, that though we should all like to accept it, any reasonable explanation of the phenomena which enables us to escape from it must be favourably considered. This book of the eminent Cambridge professor is mainly devoted to the group of phenomena whose principal features I have been recalling; but among the investigations to which Röntgen's discovery has given rise, none are comparable in importance to that along whose track certain French physicists have been led by a happy observation methodically followed up.

It is curious that for a long time French physicists took scarcely any interest in the question of discharges in gases till the discovery of a group of phenomena even more surprising than the last placed them at the head of contributors to the new science. M. Becquerel's demonstration of the peculiar radiation from uranium was, for the moment, so disconcerting, that many persons declined to treat it seriously, on the ground of the smallness of the effect. This could not last long. Mme. P. Curie, simultaneously with M. G. C. Schmidt, discovered that another body, thorium, emits radiation similar to, but more powerful than, that of uranium. Employing radio-activity as a delicate reagent, she found that certain minerals possess this property to a higher degree than the pure metals in which it had been first observed. Two hypotheses occurred to her mind. Either radio-activity is increased by the combination of certain bodies, or if it is a property associated with the atom, the minerals in question contain small quantities of unknown elements which are radio-active to an extraordinary degree. The first hypothesis appears improbable in view of the results of certain experiments. M. and Mme. Curie took up the task of concentrating the unknown elements. Finding out the mode of procedure by trial, they succeeded in concentrating from some tons of pitch-blende a few decigrammes of several materials possessing in an unhoped for degree the properties which had at first been only observed in uranium and thorium.†

The properties of these bodies are intimately associated with those of electrical discharges in gases. Their power of discharging electrified bodies, discovered for uranium by M. Becquerel, enabled M. and Mme. Curie to test continually the process of concentration; and their radiation, on the other hand, is very similar to the pseudo-radiant phenomenon observed inside and outside an exhausted tube under the action of an induction coil. These new elements, the radium and polonium of M. and Mme. Curie, and actinium discovered by M. Debierne, emit a form of energy composed of two absolutely distinct parts. One part is unaffected by an electric or magnetic field, and may with good reason be looked on as an ethereal wave. The other part is deflected in an electric or magnetic field, and behaves like a collection of moving charges. Moreover, M. and Mme. Curie have succeeded in demonstrating the convection of negative charges; a particularly difficult experiment on account of the property of the non-deviable rays, perhaps, too, of the deviable, of rendering gases good conductors. The second kind of radiation is in every way similar to a stream of matter charged with negative electricity derived from its source, which itself becomes positively charged, except in so far as it is continually restored to equilibrium with the surrounding air rendered conducting by the other part of the radiation.

The velocity of the non-deviable radiation has not yet been determined, since none of the methods employed to measure the velocity of light are applicable to it, and it is probable that this quantity, which, as in the case also of the Röntgen rays, would decide its character as an ethereal undulation, will long remain unknown. On the other hand, by making certain hypotheses the speed of the deviable radiation has been estimated at about half that of light, a quantity of the same order as that of the rays emitted from the cathode of a vacuum tube. This speed is so enormous for material particles that it might suggest doubt about the corpuscular nature of the radiation, but all its other properties agree so well with this idea that one may well consider whether it is not more reasonable to modify one's views on possible speeds than to reject an hypothesis to which logic can find no objection.

All physicists know how a series of phenomena which appear to be entirely distinct may be really repetitions of the same phenomenon differing in intensity. The identification of lightning with the spark of an electrical machine, of luminous with electric waves, of the attraction of the earth with that of bodies around us, has been the result of long and profound meditation by the greatest intellects of which humanity can boast. One knows that a bullet moving with a velocity of 1 cm. per second possesses none of the visible properties of one fired from a gun at a speed of 1 km. per second. In the first case it will be stopped by a sheet of paper; in the second it pierces wood a metre thick. Moving slowly it is clearly seen, moving fast it is absolutely invisible, though we hear the hiss of its passage through the air. Thus, if ignorant of the true nature of the bullet, we were reduced to the evidence of our senses; if, though seeing the destruction occasioned, we could not stop it and examine it at rest, we might never recognise the identity of the natures of the two balls moving with such different speeds.

It would be impossible to say to-day what would happen if our projectile had a velocity of 100,000 km. per second, for the phenomena would bear the same sort of relation to those produced by a rifle bullet as the latter bear to those of a bullet moving 1 cm. per second. Considering, moreover, that we do not yet know in what state of division is the matter in the cathode ray, or in that emitted from radium, but are sure that we know of nothing else in the same condition, it is easily understood that the phenomena of this supposed emission may well be so strange as to appear inexplicable.

Polonium does not seem to give a deviable emission, while radium, on the other hand, gives two emissions. This point, however, need not delay us now. It is not surprising that these emissions are very penetrating, at least in their own particular way, for in air their range of action is very limited, and still more so in solid bodies. But while a beam of light visible in air for 100 kms., is stopped by one-thousandth of a millimetre of iron, the emission of radium which is stopped by a few centimetres of air, can traverse a centimetre of the most opaque body. The penetrating power of these rays follows curious laws. It is not subject to the exponential law, and departs from it in some cases in one sense, in others in the other. Moreover, the opacity of a given obstacle varies with its distance from the source.

The emission from radium illuminates sensitive screens, decomposes photographic preparations, and provokes other chemical action. It condenses the vapour of water, either by furnishing directly the necessary nuclei, or by a preliminary action on the molecules of air, whose ions become centres of condensation. On the other hand, MM. Curie and Sagnac have shown that Röntgen rays striking a metal surface cause an emission of matter charged with negative electricity. They do not seem to pulverise the metal, as MM. Lenard and Wolf supposed to occur with ultra violet light at a time when no cause but dust was known for the condensation of vapour, and when Aitken's effect seemed to admit of but one interpretation. The deductions drawn by MM. Lenard and Wolf from their beautiful experiments have long been doubted. The experiment of MM. Curie and Sagnac at once determines the nature of the secondary rays so well studied by the latter observer, and shows that their explanation by the hypothesis that a part of the double layer is removed and transported by carriers of atomic dimensions is more probable than that proposed by MM. Lenard and Wolf. The secondary rays have thus the character of cathode rays, able to produce Röntgen rays by a successive degradation, and by the transformation of part of their energy into heat.

In radium, which gives both an emission similar to cathode rays, and a radiation identical with X-rays, each of the two phenomena might be the primary, and cause the production of the other as a secondary effect, so that when the cause of one is known, the other will also be explained. But for the present we are far from any satisfactory theory of either. The perfect similarity between a small quantity of radium and a Crookes tube should, it would seem, assist one to understand the constitution of this body, which is so mysterious that, were it not known to exist, one would deem it impossible and contrary to all known laws. But in a vacuum tube the source of energy is known, while in radium it is not yet ascertained. Moreover, knowing that this body continually projects particles with an immense velocity, one may fairly ask how it is that if this velocity exists among the atoms, the body itself is not instantly dissipated, and one is thus led to look on the non-deviable radiation as the primary phenomenon.

The questions raised by the discovery of these new bodies are evidently of great complexity, and even when the nature of the action is known, many will still be unanswered. Lying, as they do, on the borderland of two departments of physics, and involving

* The tendency of all rarefied tubes to become hydrogen tubes has long been known. Sir William Siemens used the fact to support his regenerative theory of the sun, published in 1883. [Trans.]

† An account of the discovery and properties of polonium and radium was given in the Electrical Review of February 3rd, 1899.

the Light Railways Act in order to obtain powers to construct electric tramways.

Thomson.

many unknown relations between matter and the ether, these problems may be the bases of great advances in our knowledge of those relations; and to have put us on the right road to their solution will not be the least of the services rendered by the study of electrical discharges in gases.

A PUBLIC DANGER.

The connection of electricity with sulphuric acid is not, perhaps, very close, but, nevertheless, the acid is an important item in secondary batteries. We think, however, that we have sufficiently good reason to step a little out of our usual way in order to draw attention to a horrible form of danger to which we are all exposed through the carelessness with which that most dangerous article, sulphuric acid, is invariably carried about. A usual vehicle is a lorry without sides. This is piled up with carboys of acid, not merely in one layer, but tier on tier. A rotten rope is, perhaps, all there is to prevent any carboy from falling off. Or the acid is packed in a high wagon and the carboys are loaded even on to the let-down tail board. A few months ago such a vehicle was proceeding from Oldbury to the Lye along the route of the Dudley and Stourbridge tramway, when it was run into in a fog by a tramcar, and one of the carboys which was so loaded that it actually overhung the tail board, fell off upon the car platform, swilling the poor motorman with the corrosive liquid. As a result the man lost the sight of an eye and is disfigured for life in a most painful manner. The people who were responsible for this cruel injury are not, so far as we know, legally responsible.

On one occasion along this same road a similar vehicle got adrift on a steep part of the road and finally was wrecked and discharged its load of acid into a row of cottages, the floors of which were flooded, though, fortunately, no person was wetted by the accident. What we wish to call attention to is the fact that anyone might be swilled in corrosive acid by the dropping out of a lynch-pin from the axle of one of these improper vehicles, and condemned to walk through life, veiled like Mokanna, with the most awful injuries it is possible to happen to a human being. We think nothing too bad to be said of any person or persons who wilfully, and after warning, should load and carry acid in this matter. Acid ought never to be carried except in vehicles, the floor of which is not above 9 inches from the ground. This can easily be done by means of a cranked axle tree. The vehicle should have high sides and should be an enclosed box, so that no serious result could occur, even if a wheel did come off. If our readers could see the dire and awful effects of strong acid upon poor humanity, we feel sure they would excuse this departure from our ordinary course and assist us by sending to us brief statements of what they may see to support such effort as may be made to bring the question before the proper authorities, with a view to some action being taken to repress the dangerous practice, and prosecute any person who will not of their own initiative protect the unsuspecting public from the danger we have pointed out, and the effect of which we have been pained to see.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

No. 25.

"Never Behind" writes:—"In Crewe, the gas company who have been supplying the public street gas lamps with gas (the Corporation at the same time owning the iron lamp columns, and the services from the base of the lamp column to the lantern), decline to do the work, at their cost, of disconnecting the gas and plugging the service pipe, in order that the same lantern and street lamp column may be used for electric installation purposes. There is no agreement in writing between the Corporation, who pay for the gas, and the gas company.

"On whom do you think the cost of disconnecting the gas mains and plugging up the same should fall—the gas company or the Corporation?

"Do you know where there has been a similar case?"

*** The question put by "Never Behind" is one which is governed by the terms of the statutes or provisional orders under which the gas company supply, and the Corporation take, gas for the lighting of the town. The provisional order under which the Corporation are empowered to supply electricity would also have to be considered. The same problem has cropped up in more than one town before now; but it seems that each case is solved according to the rules laid down in the private Acts. In Glasgow, for instance, a dispute on all fours with that alluded to by "Never Behind" took place. The gas company refused to advance the cause of an undertaking which was prejudicial to their own interests; the Corporation insisted that the right to cease to take a supply of gas involved the right to compel the gas company to disconnect, and defray the expense of disconnecting. The contention of the Corporation prevailed, as the liability of the gas company became apparent on reference to the local Acts. We are unable to give the reference to this case, and, indeed, if we were able to do so, it might well transpire that the local Acts, by virtue of which it was decided, were wholly different to those in force at Crewe.

We regret that we cannot give a more satisfactory reply to this interesting query, but it can probably be solved by "Never Behind" himself, if he will refer to the statutes to which we have drawn his attention. If not, he should submit them to his legal adviser.

No. 26.

"Electro-Metallurgy" writes:—"May I ask, through your inquiry columns, some enlightenment on the following: Can a municipal authority legally tender for work quite outside their supply business? For instance, a large firm here, having their own plant, request a private firm to submit a tender for *wiring* 100 lights in their offices, to be coupled to their own mains, absolutely nothing to do with Corporation mains. This tender is sent in, and then the Corporation appear, and send in a lower price, and *get the work*.

"This is municipal trading with a vengeance, and I should like to know its true legal bearing."

*** The substance of the question addressed by "Electro-Metallurgy" formed the basis of a query in the Electrical Review some time back. In answer to a question whether a municipal corporation could lawfully supply electric fittings, we said:—"In the absence of a provision in their charter to that effect, the corporation cannot lawfully supply fittings, nor can they sue for such as are supplied. A corporation is not bound by, nor can it sue upon, contracts which are not within the scope of its constitution, or which by the provisions of any Act of Parliament relating to the corporation it is expressly or impliedly incapacitated from making. The question seems to be answered by the case of Leicester Corporation *v.* Hill, which was decided by a County Court in March, 1898. There the company sought to recover the price of electric light fittings supplied by them. His Honour said: 'I can see nothing in the Electric Lighting Acts which authorises the company to supply anything but meters.' He accordingly gave judgment for the defendants."

That internal fittings do not come under the heading "meters" is clear enough; and speaking as we do, without any knowledge of the statutory powers of our correspondent's corporation, we agree with him that theirs is municipal trading with a vengeance, in that it is carried on apparently without warrant of law.

NEW YORK'S LATEST TRACTION SYSTEM.

New York is still improving its street and suburban traction methods. One of the latest and most important schemes is that of changing the form of power on the Manhattan elevated railway from steam to electricity. The work in connection with this change is now in full swing, and it is hoped that the whole of the work will be completed by the spring of next year; that is to say, New York will probably enter the new century with an illustration of what is to be accomplished with an exceptionally large city traction scheme for the guidance of other large cities. The power house is rapidly approaching completion; the whole building is of course of large dimensions, the four chimney shafts being about the largest in America, they are built of tiles, with a clear flue diameter of 17 feet, and a height of 278 feet above the foundations. The normal total output of the generating plant will be 64,000 H.P.; that is, with the whole plant running at its limit about 100,000 H.P. would be the maximum output. The generating plant is now under construction, and consists of eight electrical generators of 6,650 H.P. each. These generators are the largest ever undertaken, and are to be of Westinghouse construction, being built by the same firm which supplied the 10 Niagara power generators of 5,000 H.P. each. The Manhattan Railway Company is thus adopting the most modern and efficient plant designed.

Some particulars of these giant generators will be of interest. They are 41 feet 8 inches high, and weigh about a million pounds. The armatures, which are fixed, are divided into four sections, in order that they can pass through the railway tunnels between the works at Pittsburg and New York. The current yielded by the generators is three-phase alternate at 12,000 volts pressure, at which pressure the energy is to be transmitted to the sub-stations, four of which are already built. The electric plant for the sub-stations has also been ordered, and is under consideration at the Westinghouse works; it consists of 78 transformers of 666 H.P. each, reducing the main transmission line pressure; and 26 rotary converters of 2,000 H.P. each, changing the three-phase current of reduced pressure to a direct current at 550 volts, the form in which it is to be utilised on the railway.

The track is fitted on the third-rail system. The third rail is of T section, weighs 100 lbs. to the yard, and is supplied in 60-foot lengths. The rail is laid on chairs supported on vitrified earthenware bell insulators. Five holes are drilled in each end of the

his regenerative theory of the sun, published in 1883. [Trans.]

† An account of the discovery and properties of polonium and radium was given in the ELECTRICAL REVIEW of February 3rd, 1899.

evidently of great complexity, and even when the nature of the action is known, many will still be unanswered. Lying, as they do, on the borderland of two departments of physics, and involving

lengths, of which only one is used for the bolting of the tie-plate, the other four being used for copper bonds.

The bonds are solid with the exception of those at every fifth joint, where an expansion joint is put in the rail length, and flexible bonds are used.

The rail itself has been specially manufactured to secure the highest electrical conductivity; to this end the quantities of carbon and manganese in the steel were kept as low as possible, the percentages being:—Carbon 0·073, manganese 0·340, sulphur 0·073, and phosphorus 0·069 per cent. The rails are found to have a resistance of 7·75 times that of a similar section of pure copper, the ordinary steel rails of the running track showing a resistance about 11·8 times that of copper.

The trains are each composed of six cars, with a motor at each end. Each motor car carries four motors of 100-H.P. each. With this power, 800-H.P., an acceleration of two miles per hour per second can be realised. This acceleration and the increased speed of trains will make it possible to increase the traffic capacity of the system by about 40 per cent., without any increase in quantity of the rolling stock. Additions are to be made, however, which will eventually double the capacity.

Of course, all stations, platforms, and trains, are to be electrically lighted, the total lighting load will be about the equivalent of 30,000 incandescent lamps.

Work is being pushed on as rapidly as possible, the trial train is completed, and practically all contracts are let.

The whole system will, it is hoped, be quite complete, and in full operation by electrical power next summer.

The Manhattan Railway Company in changing from steam to electric power for traction purposes are not speculating, in the strict sense of the term, they are only following the example of many other railway companies, who have made this change, and thereby considerably increased their profits. It would be well if some of our railway authorities on this side of the water were to follow suit, for the sake of their own pockets, and the convenience of the travelling public.

CENTRALISATION OF CONDENSING PLANT.

IN discussing this subject in the *Engineering Magazine*, Mr. H. G. V. Oldham at once points out the main cause of trouble in the number of joints in the exhaust main. Young engineers who will even pride themselves on putting up steam pipes tight to show no leaks will gaze with equanimity on a vacuum gauge at 15 inches on a condenser from which copious water is flowing at a temperature that would justify 27 inches or more. They despise the pressure of air at 15 lbs., and think that any sort of joint will keep it out. Then pipe flanges are perhaps rough, and rivetted pipes are too widely rivetted and cannot be caulked without buckling. Our author rightly says that exhaust pipes can be put in that are tight to a small fraction of an inch. The pipes are carefully made and tested, and they ought to be placed in some tarry composition in a vacuum vessel so as to empty their pores of air and fill them with tar. There is no reason in principle why a condensing plant need be placed near the engine it serves, and if several engines are scattered about they can all be worked from one central condenser. The condensing plant should thus be a separate affair, and it can very usefully be employed to help engines started under load by being itself run up previous to the engines being started.

In a steamship the auxiliaries can always use the main condenser when the main engines are at work. With separate air pumps the auxiliaries can work condensing even in port and save their condensed steam. In arranging a central plant its circumstances must be carefully considered. In a lighting station a full load is a large multiple of the minimum load. In a traction plant the load on the condenser is fairly steady, though that of the engines is not so. So also is the duty of a condenser in most factories. Our author suggests that the battery for condenser plant should be in sections —a section to each engine capable of being cut out as desired. The air pumps he would also sub-divide into units of not too large a size. He summarises the position by stating that for a constant load and several small engines there should be a central condensing plant.

The same system may be followed for large engines and similar conditions, but for variable loads of short maximum duration engines should each have their own plant, as carried out at Port-Dundas, Glasgow, where engines of 1,100 H.P. have Edwards pumps of three-crank type, electrically driven, with circulating pump and 2,500 square feet of condenser surface. At the works of Vickers, Sons & Maxim, of Sheffield, a condenser capable of producing 2,000 gallons of condensed steam per hour serves about 30 engines. It is all a question of tight exhaust main. Our own opinion is that the exhaust main ought to be put under pressure to show up its joints, and the air pump ought to be able to pump up a vacuum cold of at least 26 inches on the joints as made; the pipes and joints ought then to be well and repeatedly painted. The author advises a flat roof of concrete over the engine or boiler room, and that the condensing plant should be placed there, especially the evaporative type of condenser.

Various cooling towers are described. Fans to operate these are said to require from 1 to 2 per cent. of the total engine power, or with the circulating water pump about 3 to 4 per cent. Cooling towers usually stand 30 to 36 feet high, and occupy a ground plan of 1 square foot for each 8 to 12 H.P. They cost 20s. to 30s. per horse-power, and may reduce the temperature from 130° to 80°, which latter will enable a 26-inch vacuum to be secured. The outside air would then be at 75° Fah., with a humidity not over 85 per cent. It is desirable to have means to vary the fan speed to suit weather or load, so as not to use an unnecessarily large power.

How is it that in so many electrical stations one finds paltry "vacuums" of 15 to 20 inches, whereas in factories of older type the amount is 24 to 29 inches? Is it because of faults in attendance or faults in plant? Something of both, probably, and it is certain that better attention to joints, glands, porous pipe castings, and other smaller items, would do much to add other inches to the gauge readings. There is a lack of proportion in the senses of attendants, who do not realise that an extra inch of vacuum may be a big item for an engine whose load factor is only 20 or 30 per cent. and the average piston load probably not 20 lbs. per square inch.

HACKNEY ELECTRIC LIGHTING.

IT was only the laying of a foundation stone, but hey! what a deal it meant! It was the beginning of the end of a great controversy which had rocked the noble Vestry of Hackney in a turbulent sea of strife for many years. "At last! at last!" said one of the speakers, and the Hackney crowd took up the strain. Brooding on this salubrious spot, with Hackney Cut contiguous, and the waters of the River Lea so near at hand, it were unwise to stir up anything, even though it be on the site of a dust destructor; but we think Hackney has established a record for dilly-dallying with the question of electric lighting, and at last Thursday's function it was very hard for speakers to forget the past. In 1893 a provisional order was obtained, but it took two years to form an electric lighting committee, and another two to come to the conclusion that there was a strong divergence of opinion as to how the thing should be carried through. In 1897 the Vestry voted an even number of votes for and against disposing of the order to a company, and the then chairman wisely decided that it was too important a matter to be settled by mere casting vote, and a verdict of "not proven" was declared. Subsequently the whole question came before ratepayers at an election, and by a large majority the decision in favour of municipal enterprise was given. After a little sport with a well-known consulting engineer, the Vestry called upon Mr. Robert Hammond to prepare a report. This he did in due course, and it was agreed not to do things by halves, but to proceed forthwith with a £250,000 scheme for electric lighting and dust destructors. As was explained by Mr. Hammond in his brief statement last week, 100 miles of cables are being laid in 50 miles of streets, and a station equipment for 5,000 H.P. capacity is to be installed.

It appears to be the custom with local councillors, when there has been long delay in putting electric lighting powers into effect, to take great credit to themselves for not being in too great a hurry, because thereby they will be able to avoid the mistakes which other works have made! Up to a certain point there is something in this, but on the other hand, it is customary to forget the important fact that, had Hackney or any other district of its area commenced actual operations five years ago, instead of wasting time in wrangling, and so on, it is practically certain that to-day its district would be well supplied, and a good profit resulting therefrom. It would have been also gratified by being a great thorn in the side of the gas company, which it is so desirous of being, on account of the increased charges per 1,000.

Mr. G. A. Ogan, the chairman of the Electric Lighting Committee, who has been so unremitting in his attention to the undertaking, presided over the proceedings. Mr. Alderman Dickinson, the chairman of the L.C.C., having been duly placed in possession of the necessary tools, proceeded to perform his part of the ceremony, viz., laying the stone. One thing we must not forget to mention. With uncovered heads, and an impressive hush, the current issues of certain local newspapers were duly interred, never to be heard of again. There was never a tear, not a funeral sigh, merely the whisper of "Dust to Dust!" from an irreverent bystander, but one and all agreed that there, once for all with those papers, was also to lie buried the old ill-feeling, the malice, the old opposition of the Vestry Hall, and if they got the chance, all would work together for the good of the new undertaking. It was a trying moment, and we were glad when it was over, so that Mr. Alderman Dickinson could deliver his speech. He entertained his hearers with historical notes on the electric lighting movement in Hackney and in London generally. Out of the London local authorities, he said, 19 were already supplying, or about to supply, their own electricity. He blamed the local authorities of the richer London districts for permitting so valuable a right as electric lighting to pass into the hands of companies who were now earning very large dividends. He considered that local authorities in London had "entirely neglected their duties" in this matter! But Mr. Dickinson does not take into account the fact that when the St. James's and Westminster companies—to which he specifically referred—set out upon their respective careers, electric lighting was in such a state, that municipal authorities were not aware that in it lay such a profitable field for their enterprise. The risk of those early pioneering days had to be borne by those and other companies, and we venture to believe that municipalisation in the provinces would not have made the headway that it has made, were it not for the fact that the companies had proved beyond a doubt that electric lighting was a thing to pay well. Would Mr. Dickinson have had municipalisation of electrical works taken in hand before such a proof were obtained? And again, would he advocate that all the

municipal authorities of the London metropolitan area buy over the concerns of the City and Charing Cross Companies, the Metropolitan, the Chelsea, Kensington and Knightsbridge, St. James's, Westminster, and half a dozen other immense undertakings? £250,000 seems a large sum to Hackney people, but how many millions would have to be paid to take over all these other concerns? We rather think that the figure would be a fancy one, yet purchase is the only reasonable remedy to apply now in atonement for their "neglect of duties." Hackney, we agree, has been neglectful for reasons already stated. It did not move, nor would it allow a company to do so. It sat upon its order from 1893, and up to the present has only hatched a foundation stone. Perhaps Hackney was, after all, intended to come under the Alderman's displeasure? However, the works are commenced, and we hope that they will make headway, and make big profits, in spite of the smallness of the average rating of property in the district. Large profits do not appear to be anticipated by all, and Alderman Dickinson wisely advised them not to be disappointed if there happened to be a small loss on the works at first. There were ample other compensating advantages.

Some particulars of the scheme now being carried out were given in the ELECTRICAL REVIEW for March 3rd, 1899. We may now supplement them with other details which were prepared by Mr. Hammond for the information of the visitors.

The works will be situated upon a site of about 5 acres in Millfields Road, Hackney, and adjoining the grounds belonging to the L.C.C. The site allows for ample means of extension, and has the advantage of a frontage to the Lea River Canal, which will give economical facilities for the supply of fuel, and the shipment of clinker and ash. The engine house will be 130 feet by 50 feet. The buildings have been designed to afford sufficient space to accommodate 6,000 H.P. in boilers, engines, dynamos, and switchgear. Sufficient land has, however, been acquired to permit of a further 6,000 H.P. being added by an extension of the present buildings. In the first instance it is not proposed to erect plant of more than 3,000 H.P.; this, with the accumulators, being sufficient to supply current for about 50,000 8-C.P. lamps alight at once, after allowing for a sufficient reserve. There will be six boilers of the Babcock and Wilcox water-tube pattern, three being fired by the refuse destructor gases, and three being placed in the permanent boiler house. The ordinary working pressure will be 180 lbs. per square inch, but the refuse-fired boilers will be capable of working up to 250 lbs. per square inch, to counterbalance any irregularities in the firing. The engines are of the triple expansion type, and are designed for a working pressure of 175 lbs. per square inch. Each engine is arranged to drive two dynamos direct without intermediate gearing, and a common condenser and cooling apparatus is provided for each pair of engines. One pair of engines are being built by Messrs. Belliss and Morcom, Limited, and one pair by Messrs. Willans & Robinson, Limited, the dynamos being supplied by Messrs. J. H. Holmes and Co. A battery of accumulators, having a capacity of 2,800 ampere-hours, has been ordered from the Tudor Accumulator Company, Limited, the primary object of the battery being, as far as possible, to store for future use the energy developed in the refuse destructor at times when it would otherwise be wasted. The working pressure on the distributing mains has been fixed at 480 volts across the outer conductors of a three-wire system.

With a view to utilising to the utmost the power derived from the refuse destructor, and at the same time meeting a probable demand for power, as well as lighting, the direct-current system of distribution has been preferred.

The first contract for cables was placed with the British Insulated Wire Company, of Prescot, and the work of laying the mains is now in progress. The mains are of the triple-concentric type throughout, and are laid in stoneware and iron troughs, filled in solid with a bituminous compound. For public street lighting, arrangements have been made for the erection of 320 arc lamps, which will be run nine or ten in series across the outer conductors of the three-wire system, provision being made for controlling all the lamps from the electricity works.

The lamp pillars will be spaced from 50 to 60 yards apart, and the posts have been designed so that the top of each lamp is about 21 feet above the ground. The refuse destructor consists of 12 furnace cells, capable of burning a maximum of 150 tons of refuse per 24 hours. Arrangements have been made for the automatic handling of the refuse, so far as this is possible, from the moment it is tipped at the works to the time when it emerges from the furnaces in the form of clinker. The surplus energy will be utilised for driving the plant in the electricity works. The elevators, blast fans, and feed pumps will all be driven by electric motors. The contract for the destructor has been let to Messrs. Hughes & Stirling, of London.

ELECTRIC FEEDERS FOR MAIN-LINE RAILROADS.

AT the International Railway Congress, recently held in Paris, Colonel N. H. Heft, chief engineer of the electrical department of the New York, New Haven and Hartford Railroad, presented a study of the conditions governing the electrical equipment of railroads in this country, and an account of the experiments already made in electric traction on a large scale. Colonel Heft's conclusions looked to the development of electrically operated branches in the larger cities and their suburbs as feeders for the main line system railways. He further believes that electric traction upon the densely populated portion of main line railways—that is, in the region of suburban trains—is not only a future possibility but an absolute present necessity.

Commenting upon the matter in a recent editorial article, the New York *Electrical Review* says:—"It is pleasant to have the conclusions which have so frequently been set forth in these columns corroborated by records of real experience. The time has now come when suburban service, by which is meant passenger service covering moderately long distance at high speeds and with many stops, must be operated by electricity. The steam locomotive on such a railroad is an anachronism. It does not seem yet within the bounds of engineering practicability to construct electric systems for very long distance lines, and for the operation of high-speed trains with few stops, that will show commercial results. Electricity has absolutely displaced every other variety of tractive force, however, for the working of street railroads or passenger carrying for very short distances at low speeds and with very frequent stops. It is rapidly taking its place as the sole agency in use for what may be called intermediate service, whereby passengers are transported at higher speeds to greater distances and with fewer but still relatively many stops. The next development of passenger transportation in which it is destined to become pre-eminent is that of express and local trains between cities separated by 100 miles or less in crowded and densely populated sections. Take, for example, the whole stretch of country from New York to Boston on the one side, and New York and Philadelphia on the other. Here the density of population is as great as it is anywhere in the United States, and the vast commercial interests centred in these cities and the intermediate towns require a large amount of travel on the part of this population. There is a constant demand for better service, higher speeds, and greater facilities, and the travelling public are quick to appreciate the railroad which gives it to them. On one side of New York competition between rival lines of railroads has resulted in a service of trains, a grade of rolling stock, a perfection of schedule and management, that is not surpassed anywhere else in the world. It is in some such place as this that we must look for the first application of electricity to the main line railroad, not only for the operation of feeders, but for the working of the freight and passenger business on the railway itself. The feeder lines must come because the competition of the trolley road has grown larger and more expensive to the steam railroads by leaps and bounds. Sooner or later the railroads must go into the trolley business or else put electric trains on their branches and suburban routes, unless they desire to give up the profitable passenger traffic for short hauls, which is now a considerable item in their revenue. It will not be long before we see the electrical equipment of a main line for the simple reason that the logic of the situation absolutely requires this to be done; and even railway managers sometimes move under the pressure of necessity."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

17,811. "An improved electric arc lamp." F. H. BOWMAN and T. A. ROSE. Dated October 8th.

17,829. "An improved device for measuring upward pressures, and particularly for enabling the trolley arms of electric tramcars and vehicles being set to exert a certain upward pressure on the wire." J. WILKINSON. Dated October 8th.

17,846. "Improvements in telephones." C. SHORE and C. HEAP. Dated October 8th. (Complete.)

17,865. "Improvements in the operating mechanism of electric controllers." T. von ZWEIGBERGK. Dated October 8th.

17,904. "Improvements in or relating to electric meters." J. ELLIS. Dated October 9th.

17,916. "Improvements in dynamo-electric machines." M. W. W. MACKIE and E. J. GLYN. Dated October 9th.

17,917. "Improvements in means and apparatus for relaying electrical currents." H. W. WEBB. Dated October 9th.

17,929. "Improvements in telephonic repeaters or relays and circuits connected therewith and therefor." C. ADAMS-RANDALL. Dated October 9th.

17,941. "Improvements in or relating to electrical arc lamps." H. B. SWIFT. Dated October 9th.

18,000. "Improvements connected with overhead trolley poles used in electrical traction." W. E. ROWLANDS. Dated October 10th.

18,001. "Improvements in or applicable to switches for electro-motors." J. P. HALL. Dated October 10th.

18,006. "Improvements in conduits for electric conductors." H. TUDBY. Dated October 10th.

18,031. "Improvements in telephone systems." M. G. KELLOGG. Dated October 10th. (Complete.)

18,036. "Improvements in or relating to thermo-electric generators." A. J. BOULT. (A. Tissier, France.) Dated October 10th.

18,044. "Improvements in or relating to covering the conductors of multiple or other telegraph or telephone low capacity cables." G. E. HEYL-DIA. Dated October 10th.

18,045. "Improvements in distributing heads or terminal boxes for electric cables." G. E. HEYL-DIA and W. E. HITCH. Dated October 10th.

18,056. "Improved encasement for electric cables." E. J. KISS. Dated October 10th.

18,058. "Improvements in magnetic rotary motors." E. DINOIRE. Dated October 10th. (Complete.)

18,059. "Improvements in electrical earth lines." G. B. MAREI. Dated October 10th. (Complete.)

18,066. "Improvements in electrical exercising apparatus." A. M. CROOKER and F. N. MCDONALD. Dated October 11th.

18,067. "Improvements in electric stop motions for warping machines." F. A. Holt. Dated October 11th.

18,099. "Improvements in or relating to electrically-driven vehicles." F. Porsche. Dated October 11th. (Complete.)

18,114. "Improvements in polyphase alternating current transformers." C. Schaller. Dated October 11th. (Complete.)

18,119. "Improvements in connections for electric fuseboards, switches, and like apparatus." H. D. Barlow and L. Barlow. Dated October 11th.

18,127. "Improvements in the distribution of electricity to a plurality of electro-motors." T. von Zweigbergk. Dated October 12th.

18,156. "An improved method of automatically regulating the flow of liquids, gases, electricity, chemicals, and powders." W. P. Miles. Dated October 12th.

18,175. "An improved advertising clock either combined or not, with an electric alarum or call." P. Royer. Dated October 12th. (Complete.)

18,184. "Improvements in shades of electric incandescent lamps." The Spiral Globe, Limited, and E. A. Livet. Dated October 12th.

18,195. "Improvements in or relating to incandescence electric lamps." P. Kopp. Dated October 12th.

18,233. "Improvements relating to electric terminals for cable connections." R. F. Hall. Dated October 13th.

18,234. "Improvements in electrical switches or contact breakers." R. F. Hall. Dated October 13th.

18,235. "An improved lighting device for electrically lighting miners' safety lamps." L. N. Williams. Dated October 13th.

18,254. "An automatic switch to be used on wires carrying electric currents for the purpose of cutting off these currents when the main wires break from any cause, or are otherwise interrupted." P. Browne. Dated October 13th.

18,282. "Improvements in the junction boxes for electric cables, and in forming branch connections therefrom." J. A. Jeckell. Dated October 13th. (Complete.)

18,283. "Improvements in junction boxes suitable for connecting electric conductors." J. Hetherington and The British Electric Transformer Manufacturing Company, Limited. Dated October 13th.

18,284. "Improvements in electric transformers." A. F. Berry and The British Electric Transformer Manufacturing Company, Limited. Dated October 13th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

25,863. "Improvements in and in connection with radiating axles for electrically propelled railway or tramway cars." Siemens Brothers & Co., Limited. Siemens & Halske, Aktien Gesellschaft.) Dated December 7th, 1898. Relates to means for enabling radiating driving axles to be employed without pivoted frames on electrically-propelled vehicles. On the electromotor casing, which is connected to the axle, is fixed a pivot engaging with a socket on the underframe of the car, while the axle boxes are made capable of shifting relatively to the car body, so that the propulsion is transmitted from the driving axle to the body through the pivot. The wheels are caused to take the radial position on curves by the action of their own flanges, or by means of one or more auxiliary wheels combined with the motor casing and guided by the rails or by the slot rails. The axle is held in the normal position by a lug on the motor casing engaging springs on the bearer. An auxiliary axle and wheels in bearings on the motor casing to control its position is provided. In a modification, the bearings of the auxiliary axle are on the car body and the axle then slides transversely thereto. A guide wheel is carried by a rocking bar which supports the motor. 3 claims.

25,895. "Improvements in and relating to electric switch or key lampholders or sockets." P. G. Ebbutt and Veritys, Limited. Dated December 8th, 1898. Relates to a key or like switch for a lampholder. The interior portion is made up of three sections. The upper and lower sections are porcelain or like blocks fitted with terminals and contacts. The intermediate portion consists of a frame in which is fitted the rotary disc carrying contacts adapted to engage the fixed contacts. The disc is turned by a handle or key and a cam and spring are provided to give a snap action. 4 claims.

25,896. "Improvements in connection with electric lampholders or sockets." P. G. Ebbutt and Veritys, Limited. Dated December 8th, 1898. A cylindrical insulator is made with two deep rectangular slots to receive connecting blocks and screws for securing the supply wires therein. Cylindrical holes in the insulator, below the blocks, receive plunger carriers which are secured to the blocks by screws. The plungers are made hollow and with lips which are retained by pressing in the open ends of the carriers. 2 claims.

25,955. "Improved dynamometer or weighing machine." W. P. Thompson. (H. S. Elworthy.) Dated December 8th, 1898. The pull exerted on the eyes draws the rod carrying a piston out of the casing, and compresses a rubber bag. Liquid is contained in the bag, and in a pressure gauge communicating with the bag through the port. The pull is thus indicated and, if desired, recorded. The pressure gauge or gauges may be placed at a distance and connected by pipes. 3 claims.

25,961. "Improvements in insulator brakes for electric conductors." C. Pellenz. Dated December 8th, 1898. Brackets for supporting the insulators for electric conductors are formed of four metal rods or tubes arranged in any direction. Clamps formed of a central block and outer plates are arranged to grip the bars, &c., by means of a bolt and nut or by the bolt end of the insulator shank. The insulators may be in any position, and, in the case of tubular frame bars, the wires may be carried inside the tubes to or from the insulators. 2 claims.

25,985. "Improvements in methods and means of electric ignition for explosion motors." P. Pichard. Dated December 8th, 1898. The electric circuit containing an induction coil is completed at the period of ignition by the end of the lever being drawn by the spring into the notch in the cam ring, and so causing the terminals to come into contact. The apparatus is mounted in a box of insulating material which can be turned about the axis of the cam to alter the time of ignition. 2 claims.

26,026. "Improvements in and relating to galvanic batteries." W. G. Heys. (S. Silberberg.) Dated December 9th, 1898. Relates to batteries in which a porous cell is surrounded by a solution of copper sulphate in which a copper electrode is immersed, and consists in providing the porous cell with a double wall at the part opposite the copper electrodes, so that the copper which becomes deposited coats the exterior surface of the outer wall and the porosity of the cell is not diminished. 2 claims.

26,067. "A new or improved holder for electric glow lamps." H. C. Gover and C. F. Procter. Dated December 9th, 1898. A porcelain or other insulating ring receives the cap of a lamp, and has bayonet notches to engage pins on the cap. An annular channel in the ring contains terminal blocks to which the supply wires are secured by holding bolts. The channel also contains the coiled parts of two wire springs, the ends of these being set in holes in the ring and blocks; their middle portions are formed into loops carrying buttons which bear on the contact plates of the lamp. A cap is secured on the ring by two screws, a mica or like disc being interposed. 1 claim.

26,068. "Improvements in electrical glow lamp fittings." Siemens Brothers and Co., Limited. (Siemens & Halske, Aktien Gesellschaft. Dated December 9th, 1898. Holders for screw-capped lamps are constructed without screws for holding the parts together. The central contact is carried on a metal plate and provided with a binding-screw for a connecting wire. This metal piece is held between two glass plates, and the body thus made up is passed laterally into an open cylindrical case, four legs on this being previously bent outward. The body is then pushed down in the case, and the lugs are turned inward above the ends of the glass plates. The case is provided with a binding screw for the other connecting wire. 2 claims.

26,136. "An improved electrical measuring instrument." K. Lehner. Dated December 10th, 1898. Relates to energy meters. Power supplied electrically to platinum or silver wires is measured by the thermal expansion of these causing movement of a pointer over a stationary scale, the effect of variation of temperature from other causes being neutralised by similar wires connected to the pointer but carrying no current. Each wire is attached at one end to a stationary support, and at the other end to a lever which is fulcrumed by a silk thread connecting it with the adjacent support. The longer ends of the levers are connected by threads with a pulley on the axle of the pointer. Two supports are adjustable. The wires are connected in series and supplied with current by yielding silver or platinum spirals. The instrument may be arranged so that all the wires and the threads are placed near together above the pointer axle. 1 claim.

26,153. "Improvements in and in connection with telephonic microphone apparatus for electric signalling." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft.) Dated December 10th, 1898. Telephones are arranged for use either for transmitting telephonic messages or for Morse telegraphic signals. The transmitting instrument is arranged as a combined microphone and magneto having a common iron diaphragm. The microphone is in circuit with the primary of an induction coil and the magneto coil is connected to one secondary coil; the other secondary is connected to line and the distant station. 3 claims.

26,164. "A resistance switch for electric motors." C. B. Callow and J. Eck. Dated December 10th, 1898. Resistance switch for electric motors. Two conductors (or a number of sheets) adapted to dip in a liquid resistance are suspended by cords passing over pulleys and connected to a cross-bar, which is connected to the piston of a dashpot. On the spindle is also mounted a wheel fitted with a handle, and a cord carrying a weight. On lifting the handle the weight is raised and the plates fall at a predetermined speed into the resistance. When the plates are immersed, projections on the pulleys short-circuit the resistance through a bar. The handle is held on by an armature and magnet, or by mechanical means. On releasing the handle, the weight causes the piston to descend slowly. Connection is made with the plates through the pulleys and rubbing-contacts. 6 claims.

26,214. "Improved electrical furnace." E. B. Phillips and W. H. Bray. Dated December 12th, 1898. An open furnace for making calcium carbide is built as shown in vertical section, the bottom being a block supported by a screw geared to a hand-wheel so that it may be lowered into an archway or through a floor supporting the furnace, as the carbide accumulates. In a modified arrangement, the screw is supported by a bracket on a vertical shaft, and can be turned aside with the block from under the carbide. The screw may be replaced by a rack and pinion. The ends of the furnace are formed by two electrodes which are elongated and grooved horizontally, and are movable by screw clamps, each carried by two shafts and four wheels on plates. The shafts can be turned by hand-wheels and the wheels are toothed to engage racks on the plates. 2 claims.

26,248. "Improvements in or relating to starting switches for electromotors or the like." J. W. Gibbs. Dated December 12th, 1898. Relates to motor-starting switches of the kind described in Specification No. 13,717, A.D. 1897, in which the main circuit can only be broken when all the resistances are inserted. In the present arrangement, an electro-magnetic cut-out is provided in order that all the resistances shall be re-inserted in case of a failure of the current, and a second magnet may also be fitted to produce the same result in the case of excessive currents. 2 claims.

26,251. "Improvements in the construction of electrical transformers with ventilating passages." O. T. Blathy. Dated December 12th, 1898. In order to ventilate induction coils the sections of the windings are separated by radial arms so as to leave an air space between them. In one form the sections are separated by simple radial arms of insulating material. The arms are formed with extensions which may also be connected together to form an open or closed framework. The arms may be grooved, channelled or made hollow. 5 claims.

26,257. "An improved method of and apparatus for regulating the difference of potential at the terminals of dynamo-electric and like machines." L. de Coisnay. Dated December 12th, 1898. The difference of potential at the terminals of dynamo-electric and like machines is regulated by shifting the armature longitudinally on its axis. The application of the invention to a generator driven by an electric motor is described. The armature is mounted on a hollow shaft capable of being moved longitudinally on the motor shaft by means of a solenoid supplied with the regulating current. A spring tends to retain the armature in its normal position. In another arrangement the position of the armature is controlled by a centrifugal governor under the influence of a solenoid; again, it may be controlled by a piston acted on by a fluid under pressure. When the form of armature permits, the invention is applicable to alternators as well as to continuous current machines. 2 claims.

26,310. "Improvements in junction boxes, switches, wall plugs, and distribution boards for use in electric wiring." G. A. Clark, W. McAulay and J. A. McLaren. Dated December 13th, 1898. Relates to the construction of junction boxes, the bases and cases of electric switches, cut-outs, wall and ceiling roses, and distribution boxes. The cases may be of metal and provided with sweating boxes, or may be of insulating material when such sweating boxes are not required. The conductors are separated and protected from the metal casing by layers of mica, and the face of the box closed by a sweated metal plate. The arrangements of the parts are varied to suit the different circumstances; when used to support an electrolier, the tube may pass through the cover of the rose and have a curved screw disc to receive the weight. For arc lamps the pins are socketed at each end, leads being sweated into the sockets after passing down through a divided insulating disc. In the case of switches and some wall sockets, the casing is extended backwards to form sweating chambers such as described in Specification No. 2,263, A.D. 1885, and the contact supporting disc is provided with a suitable metal cover. The provisional specification also refers to cast-iron distribution boxes, divided by an insulating partition, and having the fuse passing up a glass tube. 4 claims.

26,315. "Improvements in means for supporting electric motors for tramway cars." J. McLeod Murphy. Dated December 13th, 1898. Relates to means for supporting electromotors for tramcars. The frame of the motor is carried at one end by a spring hanger, and at the other is supported on a ball-bearing on the axle. The end of the frame is divided into two parts, having recesses which form ball races. The races are closed by caps which screw loosely into threaded recesses in the parts and rest upon the axle. To prevent the caps from turning, locking-pieces mounted on fixed brackets enter the notches. 4 Claims.

26,322. "Improvements in and relating to apparatus for regulating the difference of potential at the terminals of dynamo-electric and like machines." L. de Coisnay. Dated December 13th, 1898. (Date under the Patents, &c., Act, 1883, Sec. 103, October 7th, 1898.) In connection with the apparatus for regulating the difference of potential at the terminals of dynamo-electric and like machines described in Specification No. 26,257, A.D. 1898, means are provided which permit of the longitudinal displacement of the armature by the action of a small force. These consist of a soft iron pulley or bobbin mounted on the armature shaft, and forming in effect a continuation of the armature. In addition, the pole pieces may be provided with lateral extensions so as to avoid discontinuity in the magnetic circuit. 2 claims.

26,397. "An improved acid-proof or non-conducting material for electrical and other purposes, and method of preparing the same." C. Jung, A. Brecher and A. Kittel. Dated December 13th, 1898. Relates to a composition for use for electric insulating, acid-proof, and fire-resisting purposes, and as a substitute for ivory, horn wood, coral, marble, vulcanised india-rubber, &c. The composition is prepared by mixing the casein from skimmed milk with cellulose, aniline, or other colouring matters, a resin solution such as gum, sandarac and mastic, a resinous oil such as turpentine, and a small amount of amber solution. The mixture is treated at about 50° C., and is finally pressed into any desired shape. 8 claims.